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SCIENTIFIC AMERICAN

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LISTENING TO EUROPEAN WIRELESS STATIONS IN AN AMERICAN ATTIC—[See page 688]

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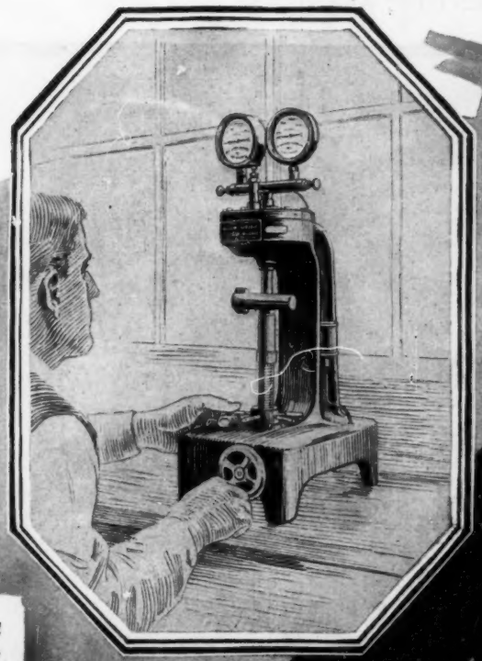

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SEVENTY-FIFTH YEAR

SCIENTIFIC AMERICAN

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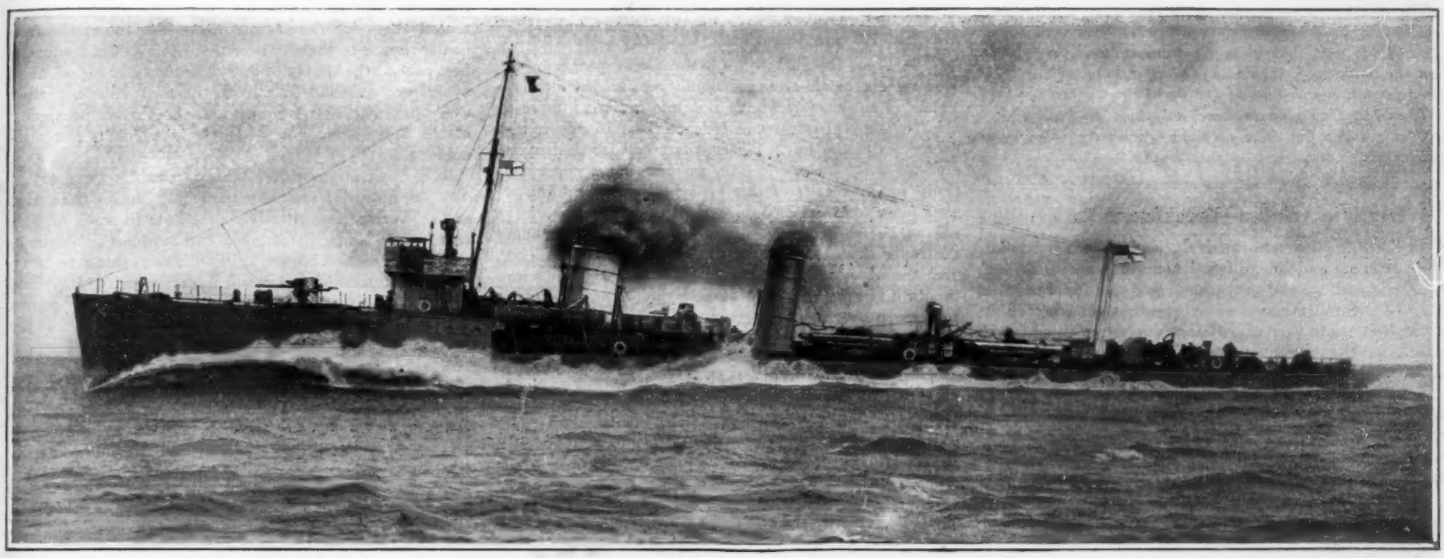

Length over all, 273 feet; beam 25 feet 7½ inches. Draft, 8 feet 2 inches. Displacement, 1,000 tons. Oil fuel capacity, 228 tons. Motive power, twin turbines direct connected. Revolutions 711. Horse-power, 26,000. Speed on trial fully equipped with fuel for 1,000 miles, 39.6 knots.

Destroyer "Turquoise", which holds the world's official record of 39.6 knots for four hours

Developing the High Speed Destroyer

THE following story concerns the last six years of destroyer construction in the British Navy, and in its beginnings it takes us back to the days of Mr. McKenna, who, as First Lord of the Admiralty, had built 60 destroyers of Admiralty design which were termed "27-knot boats." The speed of these craft varied from 27 to 29 knots. One of the best known builders of destroyers had urged the Admiralty to discontinue this class of construction, as being too slow to compete with the destroyers that were being built by the Germans, which had a speed of 30 knots. It was urged that the English boats that were being built could neither catch the German destroyers nor run away from them if they should wish to do so. Ultimately Admiral Jellicoe, when he became Comptroller of the Navy permitted Mr. Yarrow, who had been very urgent in presenting the case for the high-speed destroyer, to build three vessels from his own designs, in which he was given a free hand to embody all the latest improvements that he could suggest. The boats were to be staunch enough to stand any weather they might encounter in the North Sea and they were to show a minimum speed of 32 knots. The responsibility for this combination of high speed and sea-going ability was to be entirely upon the builder. An order was given for three vessels: "Firedrake," "Lurcher" and "Oak," which ultimately on their trials made from 35 to 36 knots. These three went through the war from the very beginning, doing excellent service, and one of them, the "Oak," was selected by Admiral Jellicoe for his service in connection with the Grand Fleet. It was these three vessels which opened the era of the construction of high-speed destroyers in the British Navy. To a great extent the lines, specifications and general design of these vessels were followed by the authorities at Whitehall.

During the war 23 destroyers of the same type as the "Oak" were built by the Yarrow firm and took part in the various operations. All of them achieved phenomenally high speeds. The record for the class and indeed the speed record for all destroyers, so far as our information goes, was made recently by the "Turquoise" on what is known as the Skelmorlie Mile, which is at the mouth of the Clyde. Here, on her official trials she attained a mean speed of 39.6 knots on a four hours' continuous run.

It should here be remarked that the Skelmorlie Mile is selected by the Admiralty as the most reliable measured mile for trials of fast vessels, because there is a depth of water of 240 feet, which is the least depth upon which trials can be made with a reliable result at the high speeds now prevailing with destroyers; for it has become known, and is now fully recognized that higher speeds can be obtained in very shallow water than in very deep water; for this reason no trials are now made by the Admiralty at the mouth of the Thames. The effect of very shallow water is to give a false increase of speed to destroyers, which in former days was never suspected.

Another famous destroyer of this type is the "Mounsey," which vessel not only attained the exceptional speed of 39 knots on her official trial, but, while on active service, was the means of rescuing 696 persons from the Cruiser "Otranto" during a gale of wind.

The "Turquoise" is fitted with 15 transverse bulkheads dividing the hull into 16 main compartments, which are further sub-divided by the watertight and oiltight decks. The petty officers' and crews' quarters are forward of the machinery space, and the commissioned officers' quarters are aft. The ventilation of the crew spaces forward is by means of a fan and system of distributing trunks, thus avoiding the necessity of cowls on the forecastle deck which are a source of trouble in bad weather.

The gun armament consists of three 4-inch quick-firing guns, one on the forecastle, one amidships between the funnels, and one aft; also an anti-aircraft gun. The torpedo armament consists of two sets of twin 21-inch torpedo tubes with four torpedoes.

The propelling machinery consists of two Brown-Curtis turbines coupled direct to the main shafts, and capable of developing about 26,000 horse-power. The boilers are arranged for burning oil fuel, and the oil fuel capacity is 228 tons.

We have been favored with the official data of the acceptance full speed trial of the "Turquoise", which took place March 14th of this year. There was no wind and the sea was smooth. In the first six miles the speeds were, successively, 39.74, 39.13, 40.00, 39.39, 40.00 and 39.30 knots, and the mean speed for the whole four hours was 39.622 knots. The mean steam pressure at the boilers was 262.75 pounds, at the engine-room 231 poonds, and at the nozzle-chest 213.5 pounds. The mean superheat througout the four hours was 95° F.; vacuum, 27.75, and mean revolutions, 711. The propellers are three-bladed, 7 ft. 11 ins. in diameter. It is probable that 35 knots contract speed will be the future minimum. War service has shown that destroyers can be built to stand hard usage.

"Turquoise" driving at high speed into a rough sea

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Lunch in America—Breakfast in Europe

SEARCH through the history of all the arts and sciences and you will find none that has furnished so much of the sensational and the heroic as the latest of them all: the art of flying—that amazing child of the Twentieth Century. Scarcely have we caught our breath at the announcement that a seabird—a boat which had taken unto itself wings—had flown from America to Europe by way of the Azores and the Spanish Main, than the message comes that a land bird, scorning its native element, had swept across the Atlantic from Newfoundland to the Irish Coast in one wild flight of sixteen hours and a half.

It should be noted that for both of these performances we are indebted to the exigencies of the great war. The NC-4, which Commander Reid piloted so ably, was built to fly to Europe and there engage in submarine warfare. The Vickers-Vimy bomber, which carried Captain Alcock on his amazing dash, was built to bomb Berlin. In both cases practically all that was necessary was to substitute an equivalent load of extra oil fuel for the load of bombs, and the machines were ready for their peacetime venture. Nor should we forget that engines of the necessary reliability and power for transatlantic flight are also a legacy of the war. The Liberty motor was not conceived until we were committed to the great struggle, and it is entirely a child of the war. The Rolls-Royce motor had won great distinction, it is true, long before the war started; but it was built only of the moderate horse-power required for automobile service. The 350-horse-power engines of the Vickers-Vimy machine are a war product.

The outstanding facts of the non-stop flight of last Sunday night are the astonishing speed of about 120 miles an hour, and the unerring precision with which Lieutenant Brown, the navigator, held his way over the course of 1950 miles. The speed and distance are those given in the cabled dispatches—the exact figures will be known when the log, times of start and stop, etc., have been analyzed and reported upon by the Royal Air Force, to which both Alcock and Brown belong.

Full particulars of the machine were given in our last issue. Its weight, as it left the ground, is stated to have been six tons. The fuel supply was 871 gallons, or sufficient for 25 hours at a cruising speed of 90 miles per hour. The meteorological conditions were good. A westerly wind of 30 miles per hour was blowing at Newfoundland, and southwesterly to northwesterly winds were predicted across the Atlantic for the next twenty-four hours. Except that a drift-indicator was carried, the navigator relied upon the sextant, chronometer and compass. According to cabled reports, the trip, because of fog, rain and sleet, was a very hard one, and only three observations, two of the stars and one of the sun, were possible; moreover but little use could be made of the drift-indicator. The poor visibility makes all the more wonderful the unerring course which was followed; for the landing was made within a few miles of the place selected by Navigator Brown. The machine left St. Johns, Newfoundland, shortly after four (Greenwich time), on the afternoon of June 14th, and landed next morning between nine and ten o'clock, near the wireless station, Clifden, Ireland.

So these gallant lads, who had lunched in America, had their breakfast, next day, in Europe.

Captain Alcock completed the flight with one-third of his fuel remaining in the tanks, sufficient for another eight hours of flying. He nursed his engines carefully, keeping them notched down for a speed of 90 miles per hour. The difference between this and his speed over the water is 30 miles; so the predicted westerly winds must have prevailed throughout the trip; and their average velocity must have been about 30 miles. If the 30-mile wind had been against him, and he had elected to run at the same cruising speed of 90 miles, his time would have been 24 hours and his fuel supply would have just sufficed to put him across.

We Should Hasten Battle-Cruisers Construction

OF all the ships of the three-year program, the six battle-cruisers should receive the first attention. We have not one of this important class of ship in our navy today. This is due to the exigencies of the war. There was a call for destroyers, and we built them. In this we gain some compensation; for in vessels of this type built and building we rank close to Great Britain, who is making an extensive sale of her slower craft, and we have a much stronger destroyer fleet than Japan or any Continental power. But the absence of battle-cruisers leaves a serious gap in our fighting line, and these ships should be given preference over any other type in the matter of appropriations and facilities.

Unless some other naval power should bring out a new design, these ships, when they go into commission, will be the most powerful and fastest of their type afloat. With the exception of the new British composite ship "Hood" they will be the longest ships in any navy, with an overall length of 872 feet. The only vessels with which they can be compared are the British "Renown" and "Repulse," drawings of which we published last week. These are just under 800 feet long. But in gun-power and speed ours are greatly superior for our ships will carry eight, 50-caliber, 16-inch guns, as against six, 42-caliber, 15-inch; and their speed, if expectations are realized will be 35 knots, as against 31 to 32 knots. The side armor was to have been 5 inches; but now that all the boilers are below deck, the armor that was assigned to the upper boilers will be available as extra protection on side or deck.

The sinking of the three British battle-cruisers at Jutland due to shell flash reaching the magazines, emphasizes the importance of giving special protection in the way of and above the magazines. It is true that two of the ships had open, or indifferently closed, ammunition hoists—something that we attended to years ago. But in all lightly armored ships in these days of heavy, long-range shell-fire, it cannot be denied that the magazines are the danger point.

Therefore we again suggest that it might be well to consider whether a drop of the speed to 33 or 33.5 knots would not release sufficient boiler and engine weight to thicken the deck protection above the magazines. Future shell-fire will be controlled by radio from unheard-of ranges and the angle of fall will be steep. Already guns are afloat that fire a 3,600-pound shell. It will take careful planning and the liberal use of horizontal armor to prevent the flash of such a shell from reaching the magazines.

Spruce Up!

A CERTAIN canny countryman found that his house needed a coat of paint and a fresh layer of shingles over the porch. On the basis of his old bills for similar work he fixed on $400 as a fair price; but when he called in the local contractor, he discovered it would cost him $500. So he put his foot down and said he would wait for prices to come back to the usual level.

A year or so later, sure enough, prices did come down. But when the canny one again put in motion the matter of repairs, he found that the extra year of unpainted nakedness had caused his clapboarding to deteriorate to such an extent, and that the bad shingles had allowed so much water to go through to the underpinning of the porch roof, that to put his house in order at the low prices of the day would cost $600. He is still asking himself how much he made by waiting for prices to drop.

In another case the first chapter of this series of misfortunes was duplicated. But here prices never did go down; and the thrifty gentleman finds himself in the position of the man who swore that he would never have his hair cut until Fremont was elected President.

In still another community, it was the village storekeeper who waited to have necessary repairs effected on his house and his garage and his automobile and other property. And because of his influence in town-meeting, the renovation of the schoolhouse and the building of a badly needed new bridge and the reconstruction of several badly washed-out places in the roads were similarly put over awaiting the drop in prices. The consequence was that the local carpenter was unable to meet his interest and was put out of business; four residents who had work horses but no work for them rented them for the season in another town; the feed dealer moved to the city because of this loss of trade; the best part of the supply of dairy produce was cut off when a big producer had to ship to the next village, further away but with better roads; and the general prosperity of the home town got a kick from which it never recovered.

The application of the above parables may not be obvious, but it is none the less direct. During the period of the war we concentrated all efforts in work of war-time value, and cut off labor and supplies indiscriminately from other lines. Prices of everything went up because of increased demand and reduced supply; and at the same time the machinery of daily life was getting more and more out of order, more and more down at the heel, more and more in need of extensive repair and reconstruction.

Now the pressure is relieved, not so much as regards prices, but certainly as regards the propriety of using labor and materials for whatever purpose we will. It is true that as yet we do not know what will eventually happen to prices—whether they will stay where they are or go up or fall off. But in any case, the amount of repairs that each one of us owes it to himself to make is not large, and could easily be afforded, if we but thought so.

If every one of us, by going ahead with whatever work he has to do, will contribute his mite to the general employment and the general business welfare, all will go swimmingly, and the country will regain its normal keel without mishap. But if any large number of us attempts to play the part of the canny fellow who waits for prices to go down, we are going to get left in precisely the way that the heroes of the above parables got left. The Secretary of War, realizing all this, has inaugurated a "Spruce-Up Campaign," urging everybody to help the return of normal business conditions by doing the little things that have gone undone for the past two years.

Everybody should be aboard this band-wagon; there is no excuse for a single absentee.

Waste Paper Mill Bark as a Source of Tanning

THE feasibility of using waste hemlock bark from paper mill operations for tanning purposes has been further demonstrated in recent tests made by the Forest Products Laboratory. Results obtained first in an experimental way were so encouraging that the investigation was finally carried out on a semi-commercial scale in coöperation with a paper mill a tannery, and a manufacturer of drying equipment.

It is found that no great technical difficulties stand in the way of utilizing paper-mill bark for such purposes. The product is satisfactory from the tanner's standpoint, and it can be prepared at a cost which will allow it to compete with leaf bark.

The use of paper-mill bark for tannin would mean a source of income for the paper mill from a material which is now of little or no value. It would also be the solution of a serious problem of stream pollution.

The tanner would be assured of a constant supply of dried bark which would allow him to keep much less material in stock, to reduce his fire hazard, and to wipe out the depreciation and interest charges which must be carried against a yard full of leaf bark.

The lumberman would avoid increasing difficulties of obtaining satisfactory labor for bark peeling and would do away with the fire hazard and expense incidental to the peeling and seasoning operations, all of which combine to make the production of leaf bark an unsatisfactory business, even at the present market price.

Engineering

Ticklish Tunneling Under the East River.—A very interesting bit of tunneling was recently done on the 14th Street tube under the East River, New York. The heading was being run in rock and at one point test holes showed a thickness of only eight inches of sound dry rock above the line along which the top of the tunnel was to run. As the tunnel was being driven without the use of compressed air it was decided to drop the upper heading four feet until this thin cover of rock was passed. The cast iron lining was set in place at each side of this section and then the rock was removed very carefully by using a great many holes each loaded with about one-eighth of a stick of dynamite. As each bit of rock was removed to the arch the tunnel lining was set in place. By this means the dangerous section was tunneled without breaking through the thin shell.

Sinking Caissons in Shifting Ground.—There is an electric light and power company located 200 feet from the Patapsco River, near Baltimore, Md. A cableway carries coal from the river to the power house and coal is also stored in the space between the power house and the river bank. Recently the power company started the erection of a new hoisting tower and bridge to handle coal, but the weight of the stored coal had started a movement of the ground toward the river and it was realized that the construction of the tower foundation in this shifting ground would be carried on with difficulty. It was decided to sink caissons at an angle so as to allow for the movement of the ground and this was done by suspending the caissons from a timber framework by means of cables. By letting out certain cables faster than others the desired tilt was obtained. After the caissons had been carried down through the shifting soil (a distance of about 50 feet), they were brought to plumb and the excavation proceeded under air through a twenty-foot layer of sand to hard bottom.

Highway Engineering Courses in Colleges.—In a recent issue of the *Engineering New Record*, attention is called to the weakness of road engineering courses in our colleges and universities compared with the great need for trained road engineers and material inspectors. In order to become a railroad engineer a man, after graduating from a college in which he has taken several courses in engineering, is obliged to work under the supervision of an experienced resident engineer so that he becomes thoroughly grounded in practical railroading. On the other hand, there are few schools which devote much attention to the subject of highway engineering and the men who take charge of the construction and maintenance of our public roads are largely untrained and inexperienced. Furthermore, they are constantly changing because of political changes. We are preparing to spend many millions of dollars in road construction and the spending of this money should be placed under the control of men who have received proper education and experience. There should be short courses for the many road officials who are not engineers and the public should be educated by means of public lectures, exhibits and articles in the press.

Bridging the Delaware at Philadelphia.—In a paper on the proposed Delaware River Bridge, recently published in the *Journal* of Engineers' Club of Philadelphia, Dr. Warren P. Laird points out the importance of connecting Philadelphia with southern New Jersey. At present there is a reciprocal relation between these two communities each being both producer and consumer, but there is no communication between them except by the archaic means of ferry transportation. A bridge at this point would not only be of local importance but it would also provide an alternative route for vehicular traffic between Philadelphia and New York. At present 95 per cent of the motor traffic between these cities passes over the Delaware at Trenton, but except for a very small stretch of territory there is a good highway running from Camden to New York. The plan is to run a bridge across the river from Washington Square in Philadelphia to Court House Plaza in Camden. The bridge would have to have a clearance of 135 feet above the water in order not to interfere with shipping. The river at this point is a little over one-half mile wide between pierheads. It is not intended to run railroad and electric lines over the bridge. These will probably be accommodated, at some later date, in tunnels.

Science

British Geological Society Admits Women Members.—Another of the leading scientific societies of Great Britain, the Geological Society, has decided to admit women as fellows. This step has been considered by the society on three previous occasions, with negative results.

Bureau of Mines Mission to Europe.—The U. S. Bureau of Mines has sent a special mission abroad to study the methods adopted or under consideration for restoring the mining and metallurgical plants and industries in the regions devastated by the war. The members are F. G. Cottrell, G. S. Rice, W. Perdue, and F. K. Probert; the last-named of the University of California.

Mosquitoes Two Million Years Old.—Writing on the probable antiquity of mosquitoes, as shown by the geological record, Prof. T. D. A. Cockerell, of the University of Colorado, states that the oldest forms positively identified as belonging to the genus *Culex* or other genera of the mosquito family have been found in Eocene rocks, and are probably about two million years old. A form known as *Culex damnatorum* was described by Scudder from the Green River beds of Wyoming. Another Eocene species has lately been discovered by Mr. D. E. Winchester, of the U. S. Geological Survey, near Cathedral Bluff, in western Colorado, and is to be called *Culex winchesteri*.

Pritzel's Botanical Dictionary.—According to *Science*, the unique dictionary of botanical illustrations published by Pritzel in the middle of the last century, and long since out of print, is to be brought up to date and reissued under the auspices of the Royal Horticultural Society. The original work enumerated every important picture or illustration of every known plant, giving a reference to the books and pages where they may be found. The entries number about 100,000 and run down to the year 1866. It is estimated that at least 125,000 additional entries will be incorporated in the new edition. A committee of eminent British botanists and horticulturists is in charge of the undertaking, and the U. S. Bureau of Plant Industry is to coöperate.

Goldenrod Not Responsible for Hay Fever.—A protest has recently been raised against the time-honored project of adopting the goldenrod as the national flower of the United States, on the ground that this plant is a cause of hay fever and hence nothing ought to be done that would encourage its prevalence. A statement has now been issued by Dr. W. Scheppegrell, on behalf of the American Hay-fever Prevention Association, in defense of the goldenrod. It is asserted that while the pollen of the goldenrod may cause trouble when applied directly to the nostrils or used in large quantities for room decorations, as a cause of hay fever out of doors it is absolutely negligible. "It is one of our most beautiful flowers," says Dr. Scheppegrell, "and well merits its selection as the national flower of the United States."

Lime Juice for Scurvy.—An interesting paper by four female authors, recently published in the *Lancet*, sheds new light on the old subject of the use of lime juice to prevent scurvy on shipboard. It appears that after having enjoyed a high reputation from the latter part of the eighteenth century onward, especially as the means by which scurvy was banished from the British navy, lime juice has fallen into disfavor in recent years. Arctic explorers have expressed sceptical views of its value, and it has been adversely criticized as a prophylactic or therapeutic agent in the late war. The authors report experiments on animals showing lime juice to be of little value, whereas lemon juice is effective in preventing scurvy in guinea pigs. One of the authors, Mrs. Henderson Smith, investigated the history of this remedy and made the significant discovery that the original "lime juice," which proved so effective in early days, came from the Mediterranean and, while partly derived from the sweet lime, was mainly obtained from lemons. About 1865 the British Admiralty, in order to encourage an industry of the British West Indies, transferred its contracts from Malta and Sicily to English firms and began supplying the ships with the juice of the sour lime, which, as it now appears, is useless against scurvy. This episode explains why "lime juice" has fallen into disrepute. It also illustrates in a striking manner the troubles that may arise from confusion in nomenclature.

Industrial Efficiency

Lead Poisoning is being investigated these days, because of its widespread existence in various industries. The Working Conditions Service, Department of Labor, has prepared, as a guide to industrial physicians, a schedule for the physical examinations of lead workers, in which provision has been made for covering not only the typical manifestations of lead poisoning but also for bringing out the previous history of the worker, to determine whether hazards in other industries may have had an adverse effect upon the health. This schedule has been forwarded to districts in which lead poisoning in the pottery industry has appeared.

Accidents in the Iron and Steel Industry have decreased by more than two-thirds during the past 10 years, as a result of the movement to enforce safety regulations, according to a report recently made by the Bureau of Labor Statistics. In 1907, the report shows, 245 men were killed or injured out of every 1,000 employed, while in 1917 the accident rate was reduced to 81 per 1,000. A further reduction would have been recorded in 1917 but for the dislocation of industrial processes to meet war needs, the report adds. The majority of accidents are declared to have resulted from defective machinery and the employment of inexperienced men.

Service Insignia.—It is strange to note how the war has affected persons in regard to the wearing of special uniforms or insignia. As more and more of our young men went into the khaki of the Army or the blue of the Navy, so did more and more men and women don some form of uniform or other, either as workers in some branch of war work or as employees with a public service corporation. And now the influence of the war seems to persist. Firms and public service corporations here and there are encouraging the use of insignia and service stripes. Motormen and conductors on cars and trains, who never bothered with service marks, are now to be seen with bright gold stripes. Employees of large manufacturing companies and public service corporations are in many instances being supplied with distinctive buttons, which include some form of marking to indicate the length of service. Such insignia, so it is reported, serves to encourage long service in a company.

Phosphorite Deposits in the Netherlands.—The scarcity of phosphate fertilizer in the Netherlands during the war, when imports were stopped, led to inquiry by experts if this country itself could not by some means supply the deficiency. One of these experts, it is now announced, has found phosphorite fields in the Provinces of Drenthe and Overyssel, in northeastern Holland, the deposits being grayish stones or petrifactions of all forms and sizes. Chemical analysis disclosed that they contained only 25 to 30 per cent phosphate, whereas the similar foreign substance contained twice that quantity; nevertheless the quantity was sufficient to be of great value as fertilizer. The investigation resulted in the erection of a large factory, where the phosphorite stone will be reduced to a powder, after being thoroughly washed to remove all deleterious substances. Many farmers and landowners have placed orders for the product, it is stated, and delivery will probably begin in April.

British-Made Laboratory Glass.—According to an article in the London *Times* of recent date, the manufacture of laboratory glass started at Sheffield since the war has made substantial progress, though much remains to be done if the industry is to be commercially sound and able to compete in the world's markets. Prior to the war there was no manufacture of laboratory glass in Great Britain, and the whole process, hitherto confined to Germany, had to be discovered and workers specially trained. With this object, a department of glass technology was opened at Sheffield University with the support of the Government, and today the department is turning out work said to equal anything Germany ever produced. The experimental nature of the work has made the cost of production heavier than the German article, and to help this a glass research association is being formed. The British Government has been asked to provide $364,987 over a period of five years, and the manufacturers will contribute a further sum of $121,662. It is said that the first attention of the association will be directed to problems of machinery and labor-saving devices.

Thirty Million Years Ago

Newly Discovered Pre-Cambrian Sea Wherein Earth's First Creatures Were Born

THE Smithsonian Institution, Washington, announces the discovery by Dr. Charles D. Walcott of several thousand fossils in the Canadian Rockies, of animal forms much more highly organized than those which he had found previously. Annually in summer, he has taken out an expedition to this region, devoted exclusively to collecting fossils from the formations known as the Cambrian rocks. He was the first to find many forms below the Silurian era. Heretofore, he had found nothing below the Cambrian period, and all of the latest evolutionary books of 1918 commence the period of first animals without backbones with this stage of earth's history. His new find upsets all previous discoveries and calculations, including his own, in that he has unearthed wonderful animals in fossil form far below the Cambrian era, in the Proterozoic age, in which it was supposed that only one-celled Amoebæ, etc., existed. In other words, in the geologic age in which we had supposed there was merely unicellular animal and vegetable life evolving, actual swimming and crawling water forms of animals were already dominant. Dr. Walcott says, in substance:

Explorations of Cambrian and pre-Cambrian formations have brought to light evidences of life far earlier than heretofore known. The field of the summer's investigations and collecting was the Burgess Pass Fossil Quarry, discovered in 1910, but which did not yield its treasures until after years of hard work. Burgess Pass lies 3,000 feet above Field, B. C. A section of about 180 square feet was taken out on this trip, practically exhausting a quarry which has yielded the finest and largest series of perfect Middle Cambrian fossils yet discovered, and the finest invertebrate fossils yet found in any formation anywhere. More than one and a half tons of specimens were trimmed out of the shale rocks, with the assistance of Mrs. Walcott, carried by pack horses to camp and thence to the railroad at Field, and are now in the National Museum.

It was necessary to blast out the back wall of the quarry, left from previous work, to obtain the fine pieces encased in the fossil bearing rock. When the large slabs were finally blasted loose, they were carefully split with chisel and hammer, exposing the fossil remains embedded between the laminae of compact, siliceous shale. The remarkable thing about this shale is that it preserved animals that were soft and non-resistant as jelly fish, worms and the internal part of worms and crab-like animals.

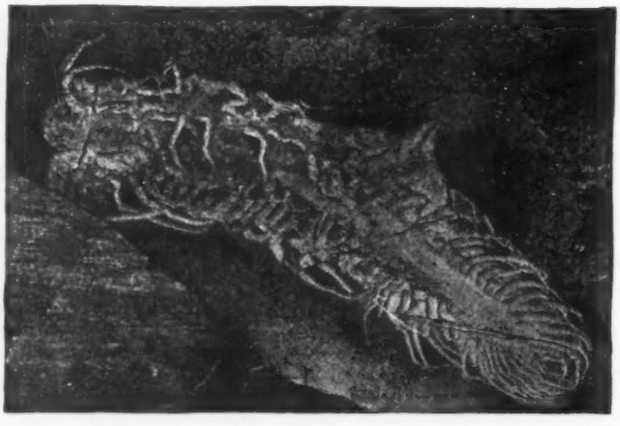
One of these earliest forms on earth, is a swimming, crawling crab, seven inches long. It had two large eyes in front, shown by round, white spots, six broad ribs and a large tail. Branchiae, or gills shine through the thin shell, as well as traces of the legs. Another curious form is a soft-bodied holothurian, or sea cucumber, with many flexible podia, or false legs. A small, round shell happened to rest on the sea bottom, just where the head part of the animal was later pressed down upon it. Another soft-bodied form is *Portali mira*, related to the holothurian, which may be seen growing on the sea bed at Santa Catalina Island, California. There was also an imprint of a mud-loving Atinian, which usually lives buried in the sand.

The shale bed at the quarry suggests that the waters of the ancient Cambrian sea above it swarmed with life, just as the ocean does today at Santa Catalina Island. But this was long before the advent of fishes on earth, so there were no fish, and no traces of them occur in the fossil bed. The superb preservation of fossils at this quarry is all the more remarkable when we consider that they have been buried for twenty million years or more, and subject to all the vicissitudes that rock materials experience from the time they are simply hardened mud, buried beneath thousands of feet of thickness of layers of mud, sand and pebbles. Then all were changed by pressure and chemicalization into solid beds of sandstone, slaty shale and limestone. These were later compressed and elevated into mountain ranges and more or less worn away by atmospheric agencies.

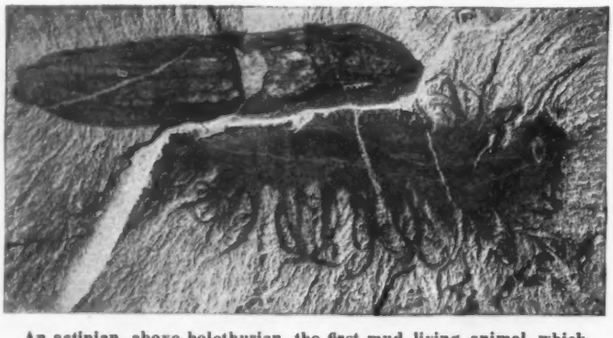
Based upon his purely geologic computation of the time rates of deposition and maximum thickness of strata from the base of the Cambrian period upward, Dr. Walcott's exact estimate of the time these strange first animals were engulfed was 27,640,000 years ago. He adds to this appalling figure, 17,500,000 years during which these and other creatures were evolving from each other, called the pre-Paleozoic period. We have then, a geological computation, based on measured rock strata, that first forms of life on earth appeared 45,140,000 years ago. Clarke finds that there has been a maximum of 64 miles of total accumulations of sedimentary rocks, equivalent to a layer 2,300 feet thick over the entire surface of the earth. Walcott has been digging up Cambrian and pre-Cambrian deposits for a number of years, in which he has found fossil remains of thousands of species of animals that preceded the evolution of vertebrates from some of them. Dr. H. F. Osborn describes the strange animals found by Walcott prior to the above discoveries as follows:

An extraordinary fine fossil of the trilobite, from which Handlirsch traces the dragon-fly, the first insect

A larger holothurian which evolved the first tube feet



An elongate, creeping holothurian (sea cucumber), which evolved the first feet and tentacles



An actinian, above holothurian, the first mud living animal, which now lives buried in sand

"The discovery of a world of highly specialized and diversified invertebrate life in the Middle Cambrian seas, completely confirms the prophesy made by Charles Darwin in 1859, as to the great duration of time that must be assigned to allow for the evolution of highly specialized forms. By the Middle Cambrian, the continental seas covered the whole region of the present Cordilleras of the Pacific coast. In the present region of Mount Stephen, British Columbia, in the unusually oily shales of the Burgess formation, the remarkable evolution of invertebrate life of prior to Cambrian time, stands revealed by Walcott's discoveries. It is at once evident that the seashore and ocean life of that time exhibits as widely divergent types as now occur. In brief, the extremes of invertebrate evolution in the seas were reached some thirty million years ago. The main feature of his discoveries is the extraordinary persistence of these types of animals from the mid-Cambrian to the present time, so that the sea forms of twenty-five million years ago can be placed side by side with existing sea forms with very obvious similarities of function and structure.

"Among the elaborate functions evolved at that period were a more efficient means of locomotion in quest of food, for escape from enemies, offensive and defensive weapons and armature, chemical modes of defense, and protection and concealment by methods of burrowing. There were heavy, protective coverings for slowly moving and sessile (without foot stalk) animals. In contrast were swiftly moving types, Sagitta, etc., which can almost be said to have been built on the lines of modern submarines, and whose mechanical means of propulsion resemble those of the most primitive, but later darting fishes. Other types such as Crustacea (shell fish), have skeletal parts for the triple purpose of defense, offense and locomotion, some being adapted to slower motion. In Paleozoic time they include the slowly moving, bottom-living, armored types of trilobites. Then there were other slowly moving, bottom-living forms, such as brachipods and gasterpods, with very dense armature of phosphate and carbonate of lime. Finally, there are floating types such as jelly fishes, chemically protected by poisonous secretions of their sting cells.

"Our first actual knowledge that such extremely ancient adaptations date back to pre-Cambrian times, is afforded by Walcott's discovery in the Grayson shales of the Algonkian Belt Series of fragmentary remains of *Beltina danai*, the highly probable ancestor of trilobites, etc. Then followed the trilobite *Olenellus* in the Lower Cambrian, with a compound phase of evolution representing the limit of trilobite development. Surface appendages found on a trilobite of this period, indicate affinities with the present day phyllopods which swarm the surface waters of the oceans. The Lingulellas, or lamp shells of 30,000,000 years ago, which were primitively armored brachiopods, remain almost unchanged today. There is little difference between the *Linguelella acuminata* of yesterday and *L. anatina* of now. The great antiquity of modern brachiopods is well illustrated by these and other forms. These lamp shells are characteristic of all ages. No changes in the world's structure concerned them. Reaching their maximum radiation during Ordovician and Silurian times, they gradually lost importance during the Devonian and Permian times, and at present have dwindled into a relatively insignificant

group, members of which range from the ocean shore to the ocean depths."

"Walcott's *Molaria* of the ancient seas may be compared with the modern living fossil, the horse-shoe crab, certainly a near relative. The two animals have strikingly similar shields, segments, etc., by which they progress on the ocean floor, well protected by their shells. The rock clinging sea cucumbers of today, protected by leathery skins and mode of hiding in crevices, differ little from Walcott's holothurians found in Cambian strata. In the calcareous plates within their leathery skins, we also see a resemblance to similar plates of modern edentate mammals. The ancient holothurians likewise developed burrowing types, as for instance, the mid-Cambrian *Louisella*, with a double row of tube feet, strikingly like the modern burrowing sea cucumber." The characteristic elongated cylindrical body form, with longitudinal muscle bands, is clearly preserved in the fossil forms brought back by Dr. Walcott's expedition.

The fossil camp (right) at Burgess Pass, and a glimpse of the explorers at work

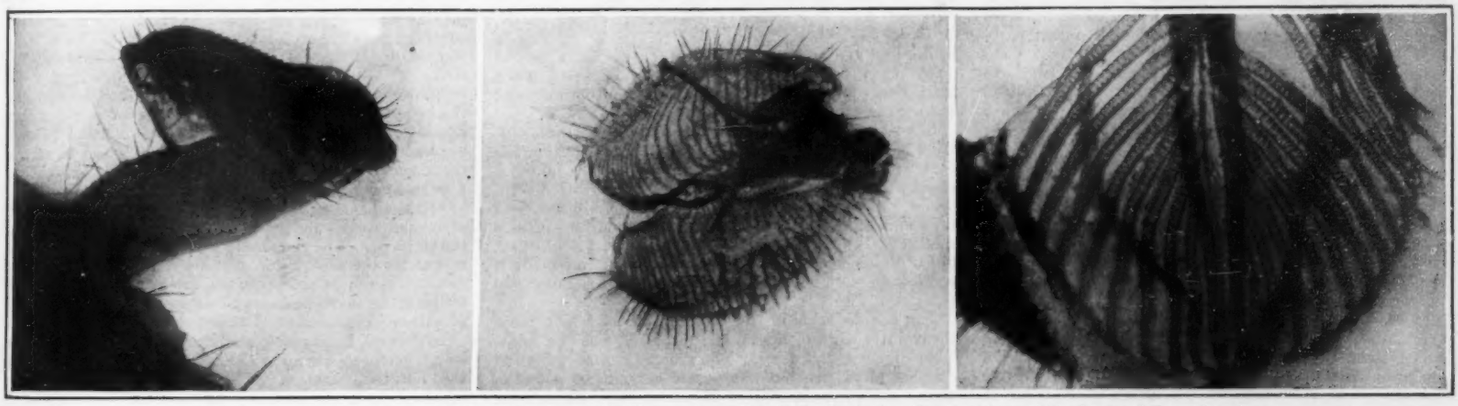
A remarkable and problematic mid-Cambrian fossil *Eldonia*, is regarded by Walcott as a free swimming, or pelagic animal. It bears a superficial resemblance to the modern medusa, or jelly fish, while the lines radiating from a central ring suggest the existence of a water vascular system, but like the swimming sea cucumber, it has the spiral intestine, seen through its transparent body wall, wholly covered with a medusa-like umbrella.

The worms, including swimming and burrowing annulates, are represented in the Burgess faunae by a very large number of fossil specimens, comprising nineteen species, distributed through eleven genera and six families. One of these has a head armed with tentacles, and the body divided into segments. It shows clear relationships with modern polychaetes. There were ancient annulates with spines, a development common with living aphrodites.

Another group of modern jelly fishes, called Scyphomedusae, is represented in the middle Cambrian by *Peytoia*, with an elliptical disk.

The evolution of Articulates (jointed segmented animals), has origin here. A pre-Cambrian annelidan (worm-like) stock gave rise to sea scorpions, armored with chitin and many jointed bodies, attaining great size by which they dominated in the Silurian seas. From these may have come land scorpions, found fossilized in the Silurian rocks, through groups of existing spider-like animals, including scorpions, spiders, and mites. It is possible also that various insects were derived from the ancient chitin armored articulates, as well as crustaceans and barnacles. As Schuchert notes, all of these later swarms of insects were attracted from water by the increasing verdure of Devonian times, making for specializations and adaptations looking toward more general feeding in air and on land.

(*Continued on page 698*)



Photomicrographs of successively greater magnification and smaller field, displaying the structure of the house fly's proboscis

How the House Fly Takes Hold

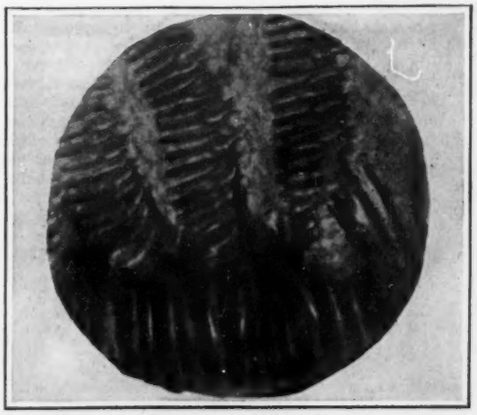
THE attempt to discover how a "sucking" insect develops the necessary vacuum pressure for such process has led to many investigations of their mouth equipment. The proboscis and the hypopharynx have been analyzed over and over again in this connection; and special importance has been attached to the contact between the proboscis and the surface upon which the insect feeds, or between the end of the hypopharynx and the tissue which it has penetrated.

There must be a method of developing vacuum pressure. If, as is probable, the proboscis performs this function, there must be an airtight contact at the point mentioned above. With this in mind, Mr. M. J. Phillips of Pittsburgh has made the photomicrographic studies that are reproduced herewith. His subject was the common house fly, *Musca domestica*.

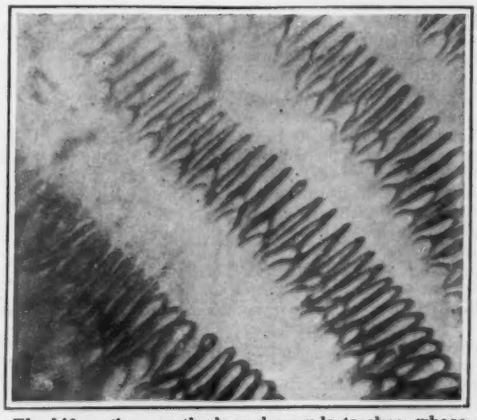
The first print gives a side view of the proboscis as a whole, taken with the 32 mm. objective and with the 10x ocular. In the second picture, taken with the same eyepiece, but with the 16 mm. objective, are shown the labella at the end of the proboscis. It is these that give contact with the surface upon which the insect feeds. They are roughly semi-circular, and hinged along the straight edge. The oval opening into the pharynx lies between them. Each has a large pseudo-trachea parallelling the straight edge, from which run laterally smaller branches. In all there are 26 of these lateral branches. Another view of the labella, showing the narrower end, follows.

In the fourth view we have a small section of a large pseudo-trachea and parts of four lateral branches. The cartilage-like rings appear now to be flexible bands, their ends not joined. Alternate bands have alternate ends bifurcated, the bifurcations resembling claws; and because of the alternation, each branch pseudo-trachea seems to have two rows of these claw-like organs. There are about fifty of these to the branch, making in all some twenty-six hundred on the two labella. This exposure shows still greater magnification, being made with the 4 mm. objective and the same 10x ocular.

The final print was obtained with the 1.8 mm. objective and the 10x ocular, aided by oil immersion and a lengthening of the camera bellows. It shows the bifurcations on parts of four branch pseudo-trachea; Mr. Phillips suggests that the functions of the bifurcated bands as here shown up, are intimately involved in the answer to the question which led him into the investigation. How this fly "bites," as many persons insist it does, is difficult to explain unless there is a sharp hypopharynx which may be used as in the case of the female mosquito, the stable fly, or the horse fly. Such a possibility seems doubtful, the shape of the proboscis hardly warranting any such assumption. Yet the fly seems able to make a red mark on the skin of a child, and to constitute itself a distinct annoyance to adults.



Small section of a large pseudo-trachea of the fly's proboscis, with parts of four branches



The bifurcations on the branch pseudo-trachea, whose location is indicated on the previous print

British Textile Industries as Affected by the War

The Measures Adopted by His Majesty's Government to Keep Up Supply and Holds Prices Within Bounds

By Major H. Bannerman-Phillips

SINCE August, 1914, Great Britain has been impelled, by the overmastering drive of circumstance, to an ever-extending control of industry. As the military struggle developed in intensity and the necessity for concentrating all efforts on the war grew more pressing section after section of industry had to be taken over, and in wages, prices and profits, from raw material to finished product, placed under government control. Especially was this the case in the textile field.

The world shortage of wool which made itself felt at the beginning of 1916 forced the government to take steps to ensure not only reasonable prices, but also meeting of the heavy demands for military clothing. The home wool clip of 1916 was purchased, collection being undertaken by expert buyers serving for the purpose under the War Office. Prices were fixed, after careful consideration, at 35 per cent above those ruling in June and July, 1914.

The success of this scheme, together with the very heavy neutral and American demands for wool, led to proposals in November, 1916, for the purchase of the Australasian clip. This operation, involving an expenditure of about $175,000,000 against $37,500,000 for the home clip, was carried out through the Australian and New Zealand governments, which arranged a purchase price rather less than 10 per cent below the ruling market figure. Valuation and purchase in the colonies was entrusted to committees of trade experts appointed by the colonial governments.

The conditions which operated in 1916 made still more urgent the purchase on the same lines of the next season's British and Australasian clips; and as the result of later negotiations, a substantial part of the South African clip was likewise taken over. In addition to these outright purchases, measures were taken early in 1917 to bring under the control of the Army Contracts Department all other raw wool and wool products arriving in the United Kingdom. It is, of course, to be understood, here and below, that measures introduced in 1916 and 1917 were continued through the later years.

The wool acquired by the British government under these schemes is distributed, in priority, to government contractors pro rata on contracts in progress, and then, against rationing certificates, to manufacturers for the home and export trade. In order to stabilize trade and enable manufacturers to compete advantageously in foreign markets, this wool is issued at prices fixed over periods of six months ahead.

It became evident early in 1917 that the civilian consumption of wool must be curtailed considerably if the Allied military requirements were to be met and an adequate reserve of wool built up against a prospective decrease, owing to transport difficulties, in receipts. A system of rationing manufacturers for the ordinary home and export trades was accordingly devised. The country has been divided for this purpose into districts which each receive quarterly allowance of the wool available for civilian trade, based on their normal consumption. The allocation of the ration for each district to its manufacturers is undertaken by committees appointed by the trade. The total of raw materials called for by approved applications is compared with the district ration for the quarter; if there is a deficit, the amount to be issued against each approved application is reduced in proportion. The whole rationing scheme is supervised by the Board of Control of the Woolen and Worsted Industries, composed in equal numbers of representatives of employers, employees, and the Army Contracts Department, under the chairmanship of the Director of Wool Textile Production.

There is no doubt that this control has resulted in great economies to the state. Not only has the effect of war conditions on market prices of the raw materials been eliminated but the fixed prices have enabled the government to control the costs of production at every stage.

The Allied requirements of raw wool have, so far as possible, been satisfied by shipments from Australasia. Large quantities were disposed of to the United States government for naval and military use, in addition to a certain amount for civilian purposes; and provision was made for the wants of India and Canada. Japan received considerable quantities of merino tops made from wools combed in Australia. Tops, noils, wastes and yarns have also been freely supplied the European Allies, and every effort has been made to assist them in keeping their woolen industries working as far as practicable.

So much for wool. In other lines, with a labor supply diminished by the needs of the army, with increasing demands from British and Allied quartermasters, with restricted supplies of raw materials, the difficulty of meeting even essential requirements in certain instances necessitated the absorption by the government of the entire output of the industry. If allowed to operate uncontrolled, these conditions would obviously have caused immense price inflation. The situation was met by calling in the aid of expert advice in the matter of fabric and prices, by the negotiation of contracts, and by the use of the reserve of power existing under the Defence of the Realm Act, which it has seldom been necessary to put into actual operation. It has thus been possible to secure full data concerning costs, and to insure that contract prices allowed no more than a reasonable rate of profit.

The prohibition of jute imports, in February, 1917, was likely to lead to undue inflation of the value of stocks; so all unsold goods were taken over by the government on the basis of the market price prior to the embargo. As necessity arose this jute was distributed to manufacturers at uniform prices, based on cost plus interest, carrying and transportation charges. Likewise, although cheaper cotton substitutes were put in place of flax goods as far as possible, the army requirements for the latter were large. In August the Ministry of Munitions took possession of the 1917 crops of flax, as well as of all other flax in the United Kingdom. Purchase and sale were prohibited without a license, and maximum prices were fixed. Control was also established over the transport of flax from Russia. Still another article over which control was set is manila hemp. About 80 per cent of the consumption has been required for government purposes. In April, 1917, an order was issued prohibiting all trade in manila hemp, and the government undertook its purchase and distribution for all purposes. It is distributed on arrival to ropemakers, at fixed prices which run about $50 per ton below those ruling prior to control.

In every case the result of the summary action outlined has been satisfactory. Equitable distribution has been assured of the available supplies, and a uniform market price has been established, free from fluctuations. Competitive buying has been eliminated, and the undue profits previously resulting from private speculation have been done away with. Above all, full utilization of stocks, without hoarding, has made it possible to stretch the supply so as to meet the essential demands.

The serious crisis in the cotton industry which faced the country toward the end of June, 1917, was of a somewhat different character. The difficulty of securing full supplies of raw cotton was one of shipping, not one of actual under-production of raw materials. This, side by side with the necessity for maintaining a reasonable standard of employment among large numbers of workers, mostly women who could not well leave their locality or be absorbed by other forms of industry, led the government to take action. With the coöperation of the industry, a Cotton Control Board was set up. Steps were taken at once to prevent misuse of the Liverpool cotton market, and the main question of the dangerously low state of stocks of American cotton was attacked. Production of the mills was cut to 60 per cent, except in certain cases where a more generous allowance was made under a system of payment of levies. The sum thus utilized in safeguarding the interests of the working people in the less favored mills, prevented widespread distress which would otherwise have been inevitable. Concurrently with great economy in tonnage space, an industry vital to Britain has thus been saved from serious dislocation.

Before the outbreak of war the demands of the government for leather and leather goods were comparatively small, amounting to less than one per cent of the nation's total output in this industry. At the end of the first year of war, these demands had increased from $1,750,000 to about $75,000,000 per year; during the past 12 months of the conflict they amounted to $100,000,000.

It became clear at an early stage that ordinary forces of competition would not secure the supply of materials at any reasonable price. The army's demand was in many instances greater than all the supplies in sight; and, had a system of competitive tendering been maintained, prices would have risen to absurd heights. It was accordingly necessary to take such control both of home production and of importation as would render it certain that these demands be met.

In the early part of 1917 the previously constituted Advisory Committee dealing with leather supplies was merged into a Central Leather Supplies Advisory Committee, which contains representatives of the chief federations of employers and the leading trade unions concerned. This body formed a number of Sub-committees which have met regularly and given detailed advice to the central body. The relationship between the government departments and these Committees has been uniformly harmonious, and the existence of the Committees has contributed to the smooth running of the industry, providing, as they have done, an easy channel both for criticism and for suggestion.

The large demands for sole and upper leather for military purposes, accompanied by the fact that for these purposes only the best was acceptable, embarrassed those engaged in the production of civilian boots; and while in aggregate the extent of production has not been curtailed, it was thought necessary during the summer of 1917 to take steps ensuring that Britain's industrial workers be adequately shod during the winter months. Arrangements were therefore made, in consultation with the trade, for the production of war-time boots. These have since been supplied in sufficient quantities to meet the demands of the working population, and they will be manufactured and distributed at controlled rates of profit.

In considering the steps taken in the control of industries, reference must be made to the organization set up to utilize unserviceable supplies. Special steps have been taken to deal with all worn out textiles. Garments condemned by military units are sent to a salvage depot. Large quantities of rags are salved from all war areas. Cuttings from material supplied to contractors for making up clothing are issued at fixed prices to cloth contractors. Departments and public bodies have been warned to economize in woolens and to forward for national use all their condemned garments and rags. In addition, steps have been taken in conjunction with the National Service Department and through other organizations to encourage the civilian population to save woolen rags. Similar lines have been followed to secure the disposal to the best possible advantage of cotton rags and unserviceable cotton articles.

Arrangements were also made to deal with the salvage of boots. Boots fit for military wear are repaired for the purpose. The remainder are graded by prisoners of war under the supervision of trade experts. A system of research has been set up to inquire into the methods of utilizing old boots and scrap leather in the manufacture of various commodities of which there is a shortage.

In general, it may be stated that efforts are constantly being made to encourage and arrange experiments for the better utilization of waste products. Wherever possible, these are used as raw material for the manufacture of goods required by the state; but when this is not possible, ordinary trade methods of disposal are inquired into, and adopted if found to be advantageous. The amounts realized by the sale of such salvage during the 12 months were over $7,500,000; and of course the saving is one not to be measured at all in dollars and cents, but rather in terms of the useful materials recovered. The statement of value is made merely to give some idea of how large the feature is.

Further steps were found necessary, by means of a salvage organization within the army itself, to extend these operations to all articles of military use. At the same time a National Salvage Council was formed, consisting of representatives of the principal government Departments concerned, which dealt with all classes of waste products of civil life.

The problem of British military and civil supplies has been complicated by the demands which the Allies have made on British industries. The early course of the war depleted the manufacturing capacity of France; later Russia was even more seriously affected. These countries could look only to the United Kingdom for help. Independent purchasing by the Allies in British markets was soon found to be reacting on prices, and preventing the prompt execution of essential British orders. An Inter-Allied Committee was therefore established, under the title of the *Commission Internationale Ravitaillement*, with a view to coördinating purchases. The work of this commission had important results, beneficial to all the Allies. It brought about more economical use of available supplies of raw materials, labor and machinery; less interference with war orders; and, generally, a greater steadiness of markets with much more advantageous prices than would have been

(Continued on page 698)

Why Does a Crankcase Breathe?

How Alternate Pressure and Rarifaction are Produced by Apparently Balanced Piston Movements

FITTING a "breather" in the crankcase of a four-cylinder gasoline engine is a matter of some importance. The alternate compression and partial vacuum taking place in the crankcase at every revolution would tend, in the absence of a breather or vent, to force oil out through the bearings and then draw it back, along with more or less dust and foreign matter. The net result would be a very oily engine exterior, and dirty bearings.

This leads up, however, to something of a puzzle, for after giving the matter a little consideration one might well ask why there should be alternate compression and partial vacuum in the crankcase. The cranks are set at exactly opposite points on the crankshaft, two on one side and two on the other; therefore there must always be two pistons going up while there are two going down. All the pistons are of precisely the same diameter and all have precisely the same length of stroke; apparently, therefore, the displacement of air by the two descending pistons should be exactly equaled by the space opened by the ascending pair of pistons. At that rate there would never be any change in the cubical contents of the crankcase and cylinders and consequently no change in pressure. The truth of the matter is that there is a slight change and that it is due to the movement of the pistons.

But why? Is it not true that the pistons travel at exactly the same speeds in opposite directions? It is plain that the piston starts from a dead stop, gradually accelerates until it reaches maximum speed, and then slows down toward the end of the stroke until it reaches the other dead center and stops before starting the return stroke, so that the motion is to some extent irregular; but is it not true that whatever one piston is doing, say, on the down-stroke, the other is doing on the up-stroke?

Curiously enough, such is not the case.

The truth is that the piston travels through the first half of its downward stroke—that is, the stroke away from the cylinder head—at greater speed than it travels through the last half of the same stroke. On the up-stroke the first half is performed more slowly than the second half. So that a piston making the first half of its descent is moving more rapidly than a piston making the first half of its ascent, and displacing more air than the other makes space for; with the result that the pressure in the crankcase increases. In the second half of the stroke the descending piston is slowed down while the ascending piston is accelerated, and the result is an increase in the total amount of space and a slight degree of vacuum. Thus there are two changes in crankcase pressure at every revolution of the crankshaft.

At the bottom of all this is the angularity of the connecting rod—that is, its departure from the vertical in the case of a vertical engine, or in any case the fact that the crank end moves alternately away from and toward the produced axis of the cylinder. To explain the phenomenon, let us consider the downward stroke. The motion of the crankpin is a compound of vertical and horizontal motions. It is clear enough that the vertical motion of the crankpin must be followed by an equal vertical motion of the piston to which it is connected. It may not be quite so clear, however, that the horizontal movement of the crankpin—that is, its swing out from the center line of the cylinder—also produces vertical movement of the piston, which must be added to the other. Perhaps the easiest way to explain the point is to imagine the connecting rod with its upper end in the usual place in the piston, but the lower end, instead of being on the crankpin, arranged so that it could move only in a straight horizontal line. Starting with the connecting rod vertical let the lower end be moved horizontally. The result will be, of course, a downward movement of the piston. The point can be practically demonstrated by holding a pencil vertical to the table and moving its lower end along the table, which will cause the upper end to be lowered.

Thus the piston in following the first quarter revolution of the crank moves vertically through a distance equal to half the stroke plus the extra distance due to the angularity of the connecting rod; this distance depends upon the length of the rod in proportion to the length of the stroke. In the second quarter of the revolution, the piston still moving downward, the crank end of the connecting rod reverses its horizontal component and moves inward. Experimenting with the pencil, it is found that coming back to a vertical position raises the upper end. In the case of the piston the vertical component is much greater than the horizontal, so the piston continues to move downward, but the inward swing of the connecting rod slows it down and shortens its travel as compared with the distance traveled during the first quarter revolution of the crank. Briefly, while the crank goes through the first quarter revolution the piston makes something more than half its stroke, and while the crank goes through the second quarter the piston makes something less than half its stroke. But the flywheel keeps the crank turning at a speed that is constant throughout the revolution, and as a result the long half of the stroke is done in precisely the same time as the short half.

In the first part of the up-stroke the crankpin swings out from the center, the result being the subtraction of something from the upward travel; thus there is a short stroke, just as in the last part of the down-stroke. In the last quarter of the revolution the crank is again swinging in and the addition to the vertical component makes another long stroke, as in the first part of the down-stroke.

Now for the breathing. The point is simply that when one pair of pistons is making a long stroke, the other is always making a short stroke, though the time is the same for both. While the descending pistons are moving faster than the ascending pistons the air in the crankcase is compressed; when the ascending pistons move more rapidly than the descending pistons a partial vacuum is formed. So the crankcase breathes, even though a superficial consideration of the matter might make it seem impossible for such action to occur.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

"Chosen"

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of November 23d, your article on "American Mining Machinery for Chosen" brought out the query as to when and by whom the name of Korea was changed.

Although a fairly close student of current literature the name of Chosen is an entirely new one to me. Several others to whom the matter was presented were equally ignorant. Possibly a good many of your readers would like to be enlightened on the subject.

J. W. HILL.

Quaker City, Ohio.

*[From about 950 A. D., the name of the country in question was Kori or Koryu, whence the familiar name Korea. In 1392, when the last dynasty was founded by Li-Tan, a still older name, Chosen or Choson, from the Chinese Chao-sien, Morning Freshness or Morning Calm, was revived. This name, however, seems to have made no great headway except locally; the name Korea continued in use, and became associated with Chinese domination of the peninsula. In 1897 their country was designated Dai-Han or Tai-Han by the Koreans, and it continued, officially, under this name until the annexation with Japan. The Nipponese, in search of a name which would be free from all association with the idea of Chinese control, hit upon the ancient Chosen, and since 1910 this has been the official name for this much-christened land.—*THE EDITOR.]

The Sailor's Point of View

To the Editor of the SCIENTIFIC AMERICAN:

Just a few lines in regards to an article titled "The Ship Owners' Point of View."

Mr. Dollar's diagram showing the percentage of American goods carried in American ships since the republic was formed is pretty fair. As to conditions on the Pacific Ocean and to actions of the Seaman's Bill, I would like to say a few words, as I think it is near time that the public press would print the truth instead of using camouflage, as I don't think the great majority of the American people are feeble minded and cannot be told the truth as conditions exist.

Now, Mr. Robert Dollar should be the last man to give his opinion in regard to American Merchant Marine as the only ships that he operated under the American flag prior the year 1917 were those in the coasting trade, and they were by law compelled to sail under the American flag as no foreign ship can operate from an American port to port otherwise. In regard to Mr. Dollar's statement that in May, 1917, American shipping on the Pacific Ocean dropped to 1.97 per cent and the cause was due to the Seaman's Bill, during 1915 to 1917 the freight rates for trans-Atlantic were very high and the shortage of ships due to the action of the enemy, caused a large amount of the big ships of the Pacific Coast to come east to the Atlantic Coast for trans-Atlantic trade, and the smaller ships that were in the coasting trade of the Pacific came East to replace the steamers of the Atlantic Coast trade that were able to be sent trans-Atlantic. Therefore, you can see why the Japanese now operate 50.90 per cent of the vessels on the Pacific Ocean.

Another mistake of Mr. Dollar's is in regard to boiler inspection every year; if it were not for that a sea-faring man or a shipper would not be able to get any insurance, as some of the ships would not be safe to cross the East River. The hydrostatic pressure which is called for in the laws covering the Steam Boat Inspection does not do any harm to the boilers or pipe lines, but helps to find the defective part, therefore preventing the loss of a few lives. The clause in the Seaman's Bill which states that 75 per cent of the crew must be able to understand the English language is just lacking 25 per cent of what it should be. The final mistake of Mr. Dollar lies in the fact that the clause of the Seaman's Bill stating that he can draw half of his wages in a foreign port, does not cause the seamen to fall for the temptation of drink when the crew is made of a hundred per cent Americans. I as a Chief Engineer can truthfully state the only time I have had any trouble with my men drinking heavily was when I had foreigners in the Engineers' Department. The average American seaman is made of better stuff than that and can be relied upon to come back to the ship sober with his arms full of souvenirs instead of his stomach full of drink.

Now this is the opinion of another who sees the other side of the situation, and which should also be printed so that the people can see both sides of the story.

JOHN E. PETERSON,
Chief Engineer, Marine.

New York, N. Y.

How Will the Gasoline Engine Develop?

To the Editor of the SCIENTIFIC AMERICAN:

I have read with interest Howard Warren's article in your issue of March 22d, 1919, under this title. My associates and I have done some work along the line of using the heat from the escaping gases to generate steam to be used in auxiliary power and have shown results worth the installation in stationary engines. But when we attempted to apply this to automotive engines we found many difficulties to be overcome. Our present design is as follows:

A small boiler is mounted as a substitute for the exhaust manifold and water from the cooling system is pumped into it so as to maintain a steam pressure of 500 pounds when the engine is running. The steam is conveyed to a turbine mounted just back of the transmission and attached to the drive shaft; the exhaust steam is conveyed from the turbine to the radiator and when condensed is a part of the cooling system. The water in the cooling system is kept at a little below the boiling point. The turbine has a greater speed capacity than the driving shaft, hence is furnishing power at all speeds when the car is running in high gear. There is a steam throttle control attached to the clutch and the steam is only allowed to enter the turbine when the car is in high gear and is cut off when the clutch pedal is depressed.

A. J. EDWARDS, M.D.

Pine Bluff, Ark.

The Skip Stop Does Not Always Work

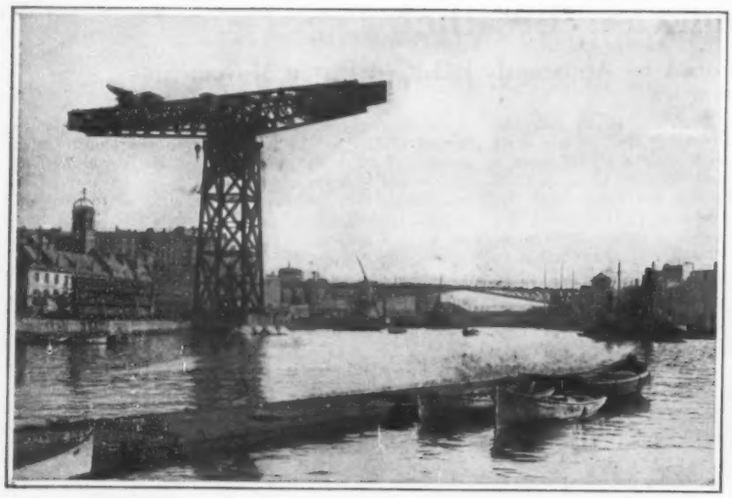
To the Editor of the SCIENTIFIC AMERICAN:

I note in your issue of December 14th, page 473, the statement that the skip stop system has resulted in a great saving of coal and time.

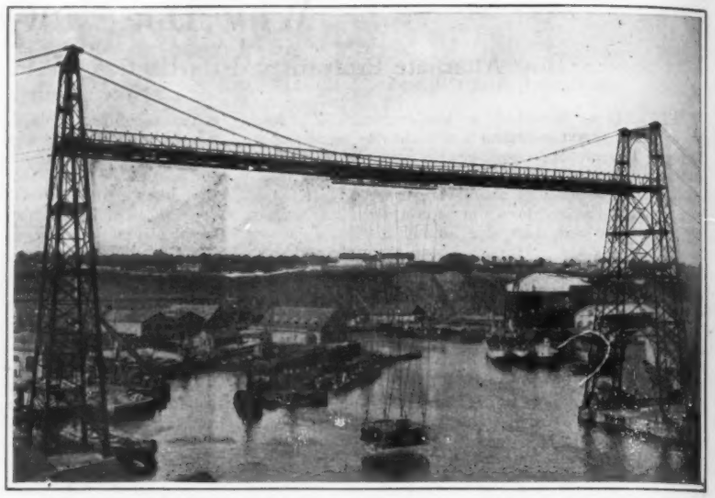
This has not been the case in Baltimore, where the president of the United Railways recently issued a statement that the skip stop system has not resulted in an appreciable saving of fuel and the little time saved is more than made up by the inconvenience caused.

CLAUDE H. HALL, JR.

Baltimore, Md.



Brest harbor, showing big crane and (in background) swing bridge



The transfer bridge between the two parts of the Brest arsenal

War-Time Construction in the French Naval Arsenals

The French Yards and Arsenals Concentrated on Army Ordnance and on Anti-Submarine and Special War Vessels

By Robert W. Neeser

A RECENT communique issued by the Ministry of Marine contained some important announcements on topics which have been hitherto banned by the censor. In reviewing the French naval effort on the high seas, M. Leygues said that on the date of the signing of the armistice, the French navy comprised 1,296 vessels of all types, exclusive of transports and ships in reserve or under construction. The greater part of this force had been built or converted for anti-submarine operations. There were 735 armed vessels intended for convoy and patrol duty, 139 submarine chasers, and 192 mine sweepers, not to mention 70 smaller craft available for harbor dispatch service.

It is an axiom of naval warfare that each conflict on the high seas witnesses the creation of a new type of warship. In this war not only one, but several classes were produced to meet new conditions, and when note is made of the number and variety of the anti-submarine vessels fitted out for the French navy a more adequate conception is had of the immense effort made in the arsenals of the "Cinque Ports" during the continuance of the war, and this in spite of the fact that since the very first day of the mobilization in 1914 the navy yards had been obliged to meet the requirements of the army on shore as well as the needs of the forces afloat.

In this connecton, the following list of the material manufactured by the various naval arsenals for the Ministry of War between August 2d, 1914, and November 11th, 1918, is not without interest: 8,500 guns, 7,000 parts of guns, 1,600 gun-carriages, 30,000 carriage parts, 30,000,000 brass shell cases, 31,000,000 shells, 600,000 trench mortar bombs, 39,000,000 rounds of ammunition for field pieces, 80,000,000 parts for fixed ammunition, 36,000 army wagons, 3,500,000 parts for tents, 1,500,000 rifle parts, not to mention hundreds of tanks both large and small. "The navy saved our life at the beginning of the war," wrote Colonel Payeur to the Inspector-General of Naval Constructions, "for we did not know to whom else to apply for all the material we needed."

From the day that the true menace of the submarine campaign launched by Germany was realized, every effort was made by both public and private shipbuilding plants to meet the extraordinary demands made of them for the speedy output and equipment of new vessels. In 1916 twenty-two 350-ton gunboats were laid down. During the year following six avisos (650 tons), ten 350-ton gunboats, thirty-one patrol vessels (470, 535 and 677 tons), and six vedettes (25 and 40 tons) were launched, while in the first ten months of the year 1918, five gunboats, 76 patrol vessels, four avisos (570 tons and 5,000 horse-power), ten vedettes, four mine sweepers, (720 tons and 600 horse-power), and three dispatch boats were added to the navy list; a grand total of 177 vessels of all types aggregating 69,663 tons and 133,050 horse-power. This construction was divided among the public and private shipyards as follows:

Year	Tonnage built in naval arsenals	Tonnage built in private yards	Total tons
1916	5,600	2,100	7,700
1917	5,655	12,755	18,400
1918	7,615	35,938	43,553

When one considers the difficulties which had to be overcome to achieve these results, the effort made for the production of naval construction in France seems truly unexampled. The lack of skilled workmen, the mobilization in 1914 having reduced the number of men employed in the arsenals from 10,000 to 4,500, was a serious handicap at a moment when every shipyard was called upon to make its maximum effort. The failure of the steel works at St. Etienne to deliver all the plates and castings demanded of them, and the shutting down of the Escaut and Meuse factories upon which the navy depended for its supply of boiler tubes, not to mention the delays attending the delivery of the machinery ordered in England (these delays often extended over a period of 18 months and retarded the completion of vessels which awaited only their engines to put to sea) are also factors which complicated a situation made critical by the shortage of transportation and the losses by torpedoing of shipments of material ordered abroad.

The demand for speedy seagoing patrol vessels and avisos was met by building these craft in series or programs, in order that each successive type might embody the most recent lessons of the conflict being waged against the undersea foe. The first of these programs was carried out in 1916. The five subsequent series comprising 155 units were carried over the next two years. The seventh and eighth series (133 vessels) were under construction when the armistice was signed.

Not only were the establishments in France appealed to, but those in the United States, Japan, Canada, and Great Britain were likewise drawn upon. One hundred submarine chasers built in the United States crossed the Atlantic under their own power or were transported on the decks of merchant ships. Twelve vedettes of the Vickers type were built at Quebec, nine 1,250-ton sloops and 40 vedettes were ceded by the British government, while 12 seagoing torpedo boats (800 tons) were constructed in Japanese shipyards for service in the Mediterranean. To the above should be added 17 small trawlers built in Spain.

In the descriptive accounts of the operations of the French navy which have been appearing during the past few years, the names of the different units added to the regular naval force have not been mentioned, but we shall soon become accustomed to the revelations which will be made from time to time as the veil of censorship is gradually raised.

U. S. S. "Mt. Vernon" in dry dock in French navy yard at Brest

At the date of the declaration of war in 1914, two of the dreadnoughts of the 1911 program, the "France" (built by the Chantiers de la Loire at St. Nazaire) and the "Paris" (built at La Seyne), each displacing 23,500 tons and carrying a main battery of twelve 12-inch guns, were on the point of undergoing their steaming trials. The "Paris" definitely joined the battle fleet on August 22d, 1914, while the "France" was commissioned on October 6th, 1914. The construction of the "Bretagne," "Provence," and "Lorraine" (23,700 tons) was interrupted by the mobilization and could not be resumed until after the first year of war. These three units were an important addition to the French fleet blockading the straits leading to the Adriatic Sea and definitely discouraged any sortie by the larger Austrian dreadnoughts. The "Bretagne" was placed in service on November 29th, 1915, the "Provence" on January 29th, 1916, while the "Lorraine" hoisted the tricolor flag on July 1st, 1916.

In the battleship program for 1914 were five vessels, which in displacement, speed and armament were superior to those previously designed. They were the "Flandre," laid down at Brest, the "Gascogne" building at L'Orient, and the "Normandie," "Languedoc" and "Bearn" under construction at private shipyards. The first three took the water during September and October, 1914, while the "Languedoc" was launched in May, 1915. But shortly after their leaving their launching slips, the construction of these dreadnoughts had to be interrupted on account of the difficulty experienced in obtaining the armor called for by their design. Another misfortune was experienced in the loss of the turrets

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Lake Michigan's Encroachment on Its Coast

How the Currents are Stealing Land from the Western Shore and the Giving It Back at the Southern Extremity

By Hu Maxwell

DURING 4,000 or 5,000 years the waves of Lake Michigan have been encroaching on its western shore from the Indiana state line northward into Wisconsin; and within that time the waters have pounded into fragments and have washed away about 600 square miles of land, and its place is now occupied by water from 30 to 60 feet deep. The encroachment continues in most places where it has not been checked by the building of breakwaters along the shore. These artificial works have been constructed in many places where the attacks by waves on the shore were exceptionally severe, or where the high value of the land made it desirable that every foot of it should be saved.

In most instances, within this zone, the fight of man against the water has been a defensive one, his efforts being directed, principally, to checking the assaults of the waves and rendering the line of shore stationary. But in certain localities extensive works have been built or planned for the purpose of redeeming portions of the area formerly covered by water. Grant Park in Chicago is reclaimed land, and reclamation work is being carried out at Lincoln Park and at other points along Chicago's northern water front, and at Evanston and elsewhere still farther north.

In most places bluffs, ranging in height from a few feet to 70 or 80, constitute the shore, and the waves of the lake make their attacks against the bases of these bluffs. The soft material crumbles, slides into the lake, and disappears. Casual observation is sufficient to show that the process is rapid in some localities and slower in others, while in a few places the shore is holding its own, without any assistance from man, and has not receded any in recent years.

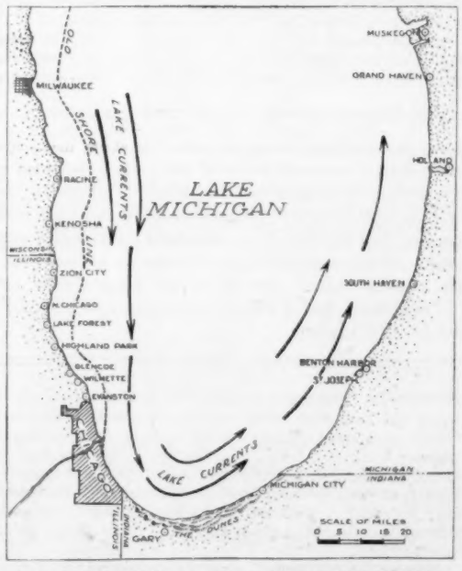
Public land on the western coast of Lake Michigan, in the district under consideration, was surveyed about the year 1835, and monuments were set up at that time at various points to mark the survey. These monuments now furnish the means of estimating the rate of the lake's encroachment upon the land. The advance of the water and the recession of the shore may be measured, and the average may be calculated for a period of approximately 80 years. The rate of recession has varied greatly in different localities, due to local influences, such as contour of the shore, exposure, form and material of the beach, and the set of the currents; but the average for the whole period since 1835, calculated for 150 miles of shore line northward from Chicago, shows that the water has encroached upon the land only a little less than three feet a year.

During single years the inroad at certain points has been much greater than that. A strip of land 16 feet deep along a part of the campus of the Northwestern University at Evanston, Ill., has been washed away in the space of 12 months; and a similar rate has been noted at the point where the Wisconsin-Illinois line meets the lake. In other localities little or no encroachment is now taking place. At Waukegan, for example, the shore, line has been stationary a long time.

The question naturally suggests itself: During how long a time has this encroachment of the lake upon the western shore been going on, and where was the beginning?

Data worked out by the Coast and Geodetic Survey for the government help to answer the question. Lake soundings reveal a submerged plateau or bench along that part of the shore which is here under consideration. The water which covers this bench is shallow, ranging in depth from 30 to 60 feet, and the plateau extends out from the present shore several miles—two or three in some places and as much as eight or nine in others. Beyond the outer edge of this plateau the bottom of the lake pitches abruptly down several hundred feet.

Rapid destruction of the lake shore at Braeside, Ill.



The present and former shore line of Lake Michigan and the currents that have piled up all this land at the southern end of the lake

That line, marking the division between the shallow and the deep water, is evidently in the place where the old shore once stood. It was the coast line of the lake before the waves began cutting back into the land. The submerged plateau or bench represents the area of encroachment, about 600 square miles, as already stated.

Here is a basis for an estimate of time, and if the figures are correct even within a pretty wide degree of approximation, they seem to bring the Ice Age considerably nearer to the present time than it has been generally placed. At any rate it is interesting to take the old lake encroachment as a factor, and see what the result is.

Assuming that the rate of recession during the past 80 years is a fair average for the whole time, it may be shown that Lake Michigan began its attack on its western coast about 4,700 years ago. That was about the time that Cheops, king of Egypt, set his slaves to work building a pyramid to perpetuate his memory. We do not know that any human beings lived on the shores of Lake Michigan at the remote age. The bluff deposits along the lake have not yielded any human relics or fossils, though there is little doubt that a few primordial Indians had followed the retreating ice of the Glacial Age northward, and were on the lake's shore even at that remote time. But whether such was the case or not, it has nothing to do with the geological question involved.

Interest in important occurrences, though remote, should lead one to inquire why Lake Michigan should have commenced cutting away its western shore at that particular time, for it is as certain as a geological fact can be that the lake was there long before. Why did it not begin its attack before?

The cause for the commencement of activity at that time is known with reasonable certainty, but the evidence is geological rather than historical.

The lake's surface, it is believed, reached its present level at that time, and then began the attack on its shore which has been kept up ever since. Before that period the level of the lake was 50 or 60 feet higher than at present, and the surplus water of the lake flowed away toward the Mississippi through a river whose channel remains to this day, high and dry, westward from the southern end of the present lake. It is supposed that the water was held at that high level by an ice gorge or a glacier which prevented escape by way of the St. Lawrence valley, as the lake is drained at present. That condition doubtless existed many thousands of years while the Glacial Age was drawing to a close. Finally, the ice obstruction gave way, the impounded waters of the Great Lakes flowed down the St. Lawrence valley, Lake Michigan sank to its present level, and it was then that the water began to wear away the shore. Apparently the time has not much exceeded 5,000 years since drainage to the Mississippi ceased and the lake's present level was fixed. The old drainage channel was forested over or grassed over when white men came, but it was so evidently a river channel that it was recognized as such by the earliest pioneers, men who had no knowledge of geology.

The destruction of land by Lake Michigan has been

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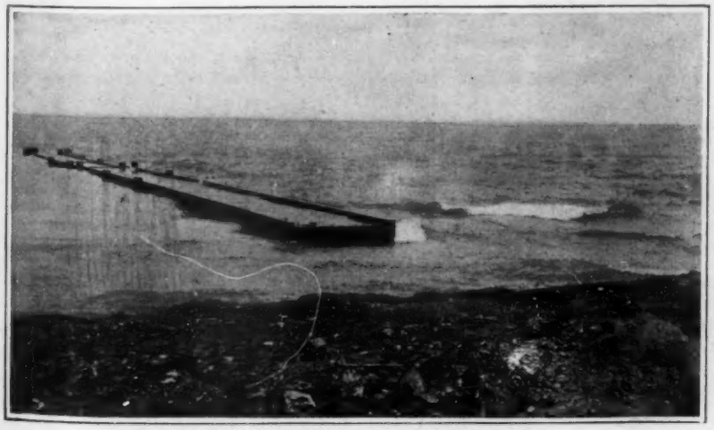
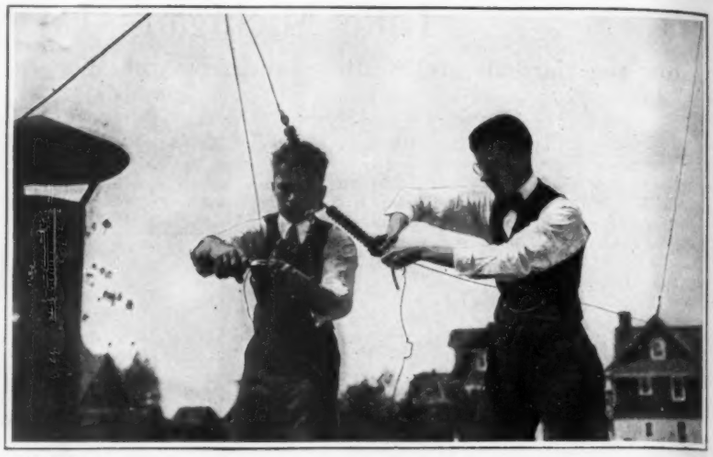


Where the shore is receding from a pier in North Chicago

Storm breaking on the shore defenses of Northwestern University campus

Receiving long-distance messages by means of vacuum tube detectors shown at right



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Amateurs at work installing their aerial, shortly after the raising of the Government ban

Amateurs in Name Only

A Story of What the War Has Done for the Cause of Amateur Wireless

By Austin C. Lescarboura

IT is no simple matter to explain why there are several hundred thousand wireless amateurs in the United States today. It is difficult to understand why a young man should place his hard-earned savings in an elaborate wireless set instead of a motorcycle or motorboat. It is puzzling to find boys, young men, and even elderly men spending hour after hour of spare time patiently adjusting the knobs of a collection of instruments, while listening to long and short buzzes and whistle-like notes issuing from a pair of telephone receivers worn on the head.

Yet the fact is that the wireless amateur exists—and in vast numbers. Even two years of enforced suspension of this hobby, due to war regulations, has only served to stimulate interest in amateur radio. Indeed, not only are all the old wireless amateurs reopening their wireless stations, but many newcomers have entered the field. The numerous important advances made in wireless telegraphy and telephony, and the startling application of these methods of communication, have served as nothing else could serve to stimulate a broad interest in this strange hobby.

IN response to many requests on the part of readers of this journal, there has been prepared a special series of articles on the broad subject of amateur wireless telegraphy and telephony. This series, which will appear regularly in the SCIENTIFIC AMERICAN SUPPLEMENT *and which begins with the issue of July 5th, No. 2270, constitutes a practical working guide to radio work. It is non-technical, yet it covers every important phase of post-bellum amateur radio. Its authors are Louis Gerard Pacent and Austin C. Lescarboura, both of whom are well-known to the radio amateurs of the country.*—THE EDITOR.

Kilowatts on One Hand, Microwatts on the Other

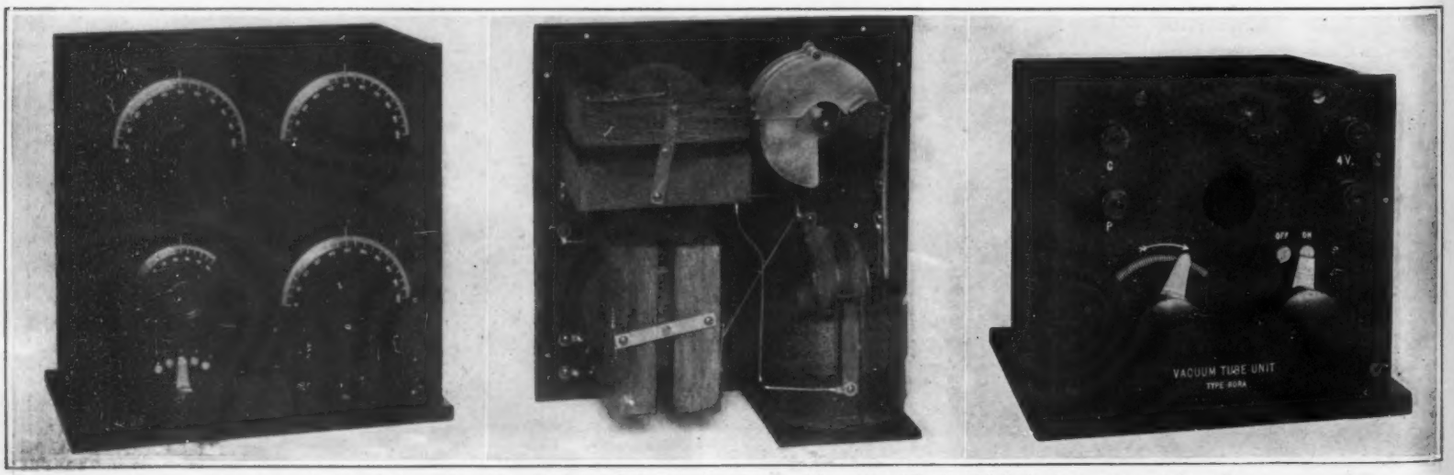
What makes radio communication so fascinating? Perhaps the answer may be found in the super-eavesdropping feature. For instance, an amateur possessing a high grade receiving set can, while sitting in the attic of his home in the suburbs of New York, listen to the messages from coast stations, steamers, battleships, and even the powerful wireless stations of Europe. By the manipulation of several knobs he can "tune in" with the Eiffel Tower at Paris, the station at Lyons, the enemy station at Nauen in Germany, and the station at Rome. He is in touch with the important centers of the world, and he receives important press dispatches long before they appear on the bulletin boards and in the newspapers. And all this without leaving his chair in the attic.

At the present writing the Government ban has been raised on receiving stations only, and the time has not yet arrived when an amateur may operate a transmitter. However, it is now but a matter of weeks or even days when the ban shall be completely removed; and then the air once more will be crowded with amateur messages passing back and forth. Obviously, a wireless station is not complete if it cannot transmit. Without a transmitter, one can listen without ever answering or questioning; but with a transmitter one can communicate with distant friends and acquaintances and carry on a regular conversation.

Still, these matters of super-eavesdropping and conversing through space do not quite cover the fascination of radio communication. There are amateurs who devote most of their time to wiring and rewiring and arranging and rearranging their apparatus. They build all sorts of queer contraptions with which they experiment by the hour, testing them for receiving or sending as the case may be. These amateurs, no doubt, are fascinated by the intricacies and mysteries of electricity as applied in radio work. One does not begin to appreciate the marvels of electricity until one delves into radio communication, where on the one hand the current is handled in kilowatts for the purpose of transmitting over long ranges, while on the other it is intercepted and passed through the receiving apparatus in volumes only measurable in microwatts or millionths of a watt, a watt being the electrical equivalent of 1/746th of a horse-power.

Then there is the matter of the inventive impulse. Radio communication is rich in possibilities; in truth, more than one amateur has stumbled across some new principle which he has developed into a commercial success. Some of the leading engineers in electrical and wireless organizations began their careers in amateur wireless. So there is always the prospect of a brilliant discovery, invention, or technical career before the amateur, and that alone seems sufficient incentive to have him wire and rewire and arrange and rearrange his apparatus many times a week.

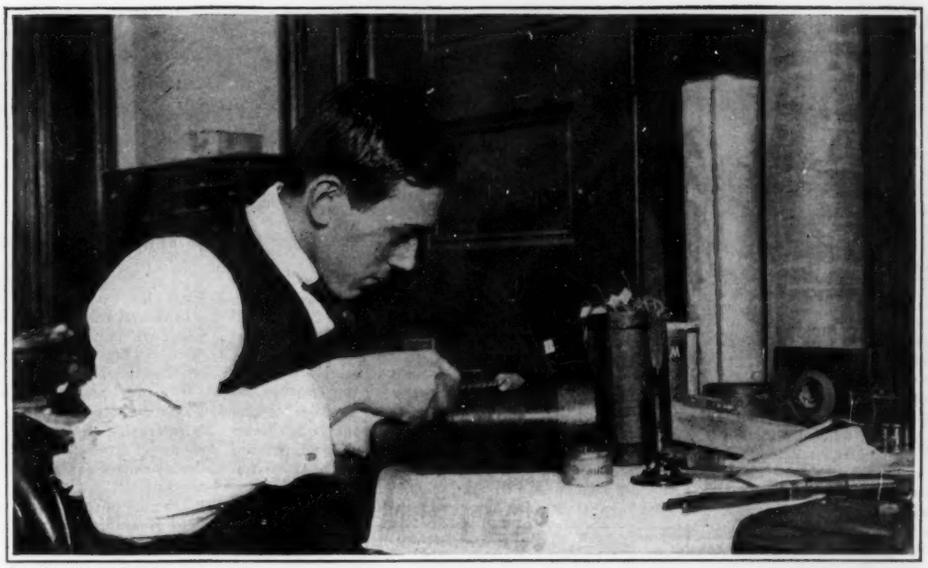
As a means of obtaining a good working knowledge of electricity, there is no better way than to become a full-fledged wireless amateur.



The first and second views show the exterior and the interior of a receiving set, while the third shows a vacuum tube unit

Radio Novelties Born of the War

From the amateur standpoint, the war has contributed a number of interesting and important innovations. Not the least important of these is the wide application of the vacuum tube which, although employed by the more progressive amateurs in pre-war days, is now used for transmitting as well as receiving. The vacuum tube is nothing more than an electric lamp of the incandescent type, containing one or more electrodes in addition to the filament. Due to the heated condition of the vacuum existing in this special lamp or tube, certain remarkable electrical characteristics result, and these have been applied to radio communication. Thus vacuum tubes are employed for detecting the weak currents induced in the receiving set by the distant transmitter, for building up or amplifying these weak currents in the event that they are too weak to be heard in the receivers after passing through a single vacuum tube serving as a so-called detector, for generating high-frequency currents used in transmitting wireless telegraph or telephone messages, and for modulating powerful currents by means of relatively weak currents.



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It used to be a regular thing to make one's own apparatus, but this is fast becoming obsolete practice

Vacuum tubes are so much more sensitive for receiving purposes than the former crystal and other types of detectors that most amateurs will use nothing else. At least, an amateur may start with the far simpler instruments for receiving; but sooner or later he comes round to the vacuum tube receiver, just as the man who starts with a $500 automobile often climbs by easy stages to the $2,500 car. The simple receiving set, costing but a few dollars, may serve quite satisfactorily for receiving messages from nearby stations. However, when the amateur wishes to keep pace with other amateurs who are in daily touch with European, Central American, and Pacific Coast stations, he must purchase the very best apparatus for the purpose.

The vacuum tubes have made wireless telephony practicable and relatively inexpensive. Heretofore, the continuous waves required for wireless telephony were usually generated by an electric arc, with all its attendant troubles such as heavy current consumption, flickering, fluctuating oscillations, microphone troubles, and so on. Today, thanks to the vacuum tubes available, wireless telephony comes well within the reach of the average amateur. A simple vacuum tube may be used together with some form of inductance, capacity, simple microphone, motor-generator set for supplying a high-voltage direct current, and other accessories, for transmitting 50 miles. Larger tubes give relatively longer ranges. At any rate, it now becomes possible for the enthusiastic amateur to install a wireless telephone set on his automobile or motorboat, so that he may keep in touch with his home or office and with other stations.

Another innovation brought about by the war is the loop. As its name indicates, this device is simply a loop consisting of numerous turns of wire. For amateur use the loop may consist of 12 turns of heavy wire, with the turns spaced ¼-inch apart; and if one desires to receive from long-range stations, the loop may be wound with 40 turns of wire. The loop serves as the aerial for receiving or sending. One side of the winding is attached to what would ordinarily be the aerial connection, while the other is attached to what would be the earth connection.

The loop, which is shown in the cover illustration of this issue, simplifies the amateur's problems. It used to be necessary to erect high poles between which were stretched the wires forming the aerial system. But, owing in large measure to the extensive use of vacuum tubes as detectors and amplifiers, it is now possible to intercept wireless waves with a simple loop placed in a room. Almost no end of interesting experiments can be carried out with loops, for these wave interceptors have marked characteristics such as direction finding and interference prevention. A loop enables one to determine the direction from which certain signals are being received; in fact, it forms the basis of the radio compass used by vessels and aircraft. Again, the loop eliminates much of the atmospheric electricity or so-called "static" which has heretofore interfered with long-distance wireless reception.

Getting Along Without Antennae

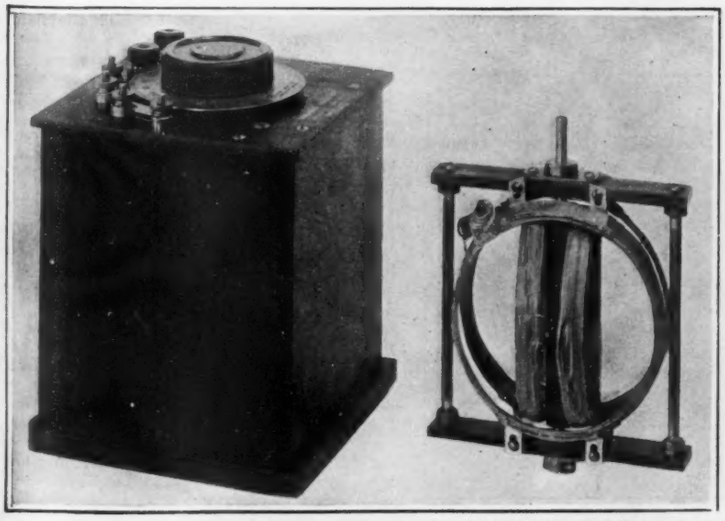
Some time ago the technical press brought out the details of an underground system of receiving perfected by an American during the course of our participation in the world war. This system makes use of a buried antenna, and, aside from the convenience incidental to doing away with elevated wire systems, eliminates most of the static interference. And since there is very little taking place in the wireless world about which the amateur is not immediately informed, it may be safely assumed that numerous amateurs will resort to this system or a modification of it. As it is, for years amateurs have made use of city gas and water pipes for antenna and ground purposes, respectively. Truly, there is very little that amateurs have not done by way of getting round the antenna problem, especially when confronted by a landlord with very little sympathy for the furtherence of science—in the radio direction, at least. Fire-escapes, bell wiring, metal bedsteads, telephone lines and electric power lines tapped through a condenser so as not to interfere with the electrical arrangements—these and many other improvisions have served as antennae where necessary.

While almost any metal mass will serve as an antenna for receiving, something more substantial is required for transmitting signals. As soon as the ban on amateur transmitters is removed there will again appear the masts and elevated wires on many of our city apartment houses and country homes.

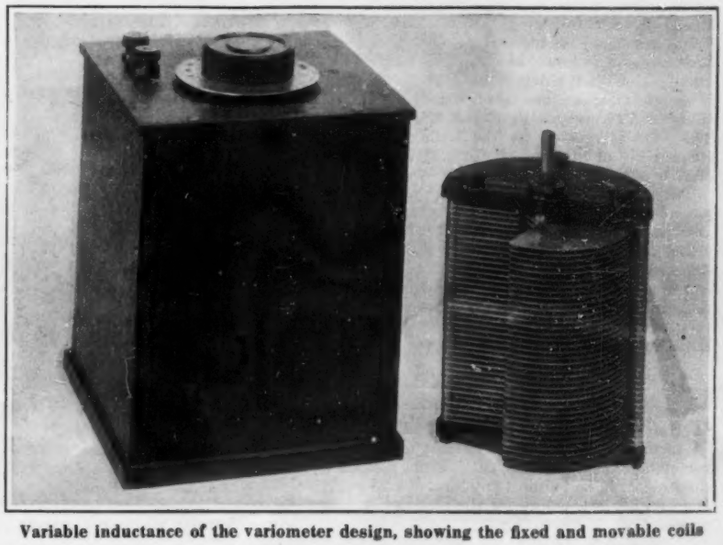
Turning to the question of apparatus, one finds that a marked step forward has been taken. In antebellum days almost anything went as wireless apparatus. In fact, nine-tenths of the amateurs made their own apparatus from odds and ends; and operating convenience counted for next to nothing. But when the war called many of these same amateurs into the naval and military service they became acquainted with commercial apparatus and soon forgot the home-made material and crude apparatus generally sold some years back. At present these so-called amateurs, who have been serving in a professional capacity for the two years of our war, are coming back into the radio experimental field with professional ideas as to equipment. They are demanding the same grade of instruments as they used in the Government service; and they are getting it.

Pre-war amateur wireless equipment was made mostly of wood for mounting the metal parts. Cheapness was the paramount consideration. Typewriter knobs were used for manipulating the various components, plain switches, stock binding posts, cheap nickel-plating. So much for the outside—the only part that showed; and it is left to one's imagination to determine what must have been the condition inside—the part that did not show. Still, what could one expect when the price was

(Continued on page 700)



Rotary condenser of the highest type, showing the operating members



Variable inductance of the variometer design, showing the fixed and movable coils

Mud Geysers at Salton Sea

By Charles Alma Byers

ON the eastern shore of Salton Sea, about seven miles from the small town of Niland, Cal., there recently has come into existence a new field of strange mud geysers. The field covers at present an area of a little more than two acres, and comprises a comparatively level expanse, save for the geyser mounds themselves, from which the water of this unnatural inland sea has gradually receded as the result of rapid evaporation. The area is already quite liberally dotted with the mounds, and new ones are, from time to time, being added.

The new field of mud cones built up by geyser action in the Salton Sink when that basin was visited by earthquakes

These so-called geysers, or "mud volcanoes," somewhat resembling huge crawfish houses, are various-sized caldrons of hot mud. In most of them the mud is bubbling almost continuously, and in others the activity is only spasmodic. The openings of some occasionally become temporarily closed, and from these there ultimately comes a considerable explosion, when both mud and steam will shoot high in the air. At such times a strong smell of sulfur or arsenic is noticeable. These explosions are naturally occasioned by the gradual accumulation of pockets of gas, and so terrific is their force that they sometimes have torn holes in the earth from 4 to 10 feet wide and to a depth of 10 or 12 feet.

The geysers frequently first appear as small spring-like fissures from which the mud bubbles but intermittently, and some of them seem to develop into nothing more. Others, either through gradual development or by suddenly springing into existence with a loud explosion, become great pot-shaped caldrons, some of these having finally, by the steady overflow or the successive spoutings of the mud, built up about them mounds as high as five or six feet.

Salton Sea, on the shore of which this field of mud geysers is located, was until about 15 years ago a dry, salt-encrusted area, known as the Salton Basin, or Salton Sink, with a maximum of 265 feet below sea level. In the latter part of 1904 the Colorado River entered upon a series of high-water rampages, and as a result temporarily converted a large irrigation canal, which tapped the stream and supplied water to several thousand acres of fertile farming land in the Imperial Valley, into a veritable river. The water thus diverted into the irrigation canal sought out the lowest depression within reach, and hence poured into the Salton Sink. After about six unsuccessful attempts, permanent control of the canal and river was acquired in the spring of 1906, but in this interim of more than two years the hitherto dry Sink became a large lake, embracing an area of about 400 square miles.

Since the stopping of this inflow of water from the Colorado River, Salton Sea has been rapidly shrinking through intensive evaporation. In ten years, for instance, the lake receded to about 93,000 acres. Scientists claim that this shrinkage will continue until 1926, when, if the present rate of inflow from two small feed rivers is maintained, the lake will be a permanent, stationary body of water covering between 40,000 and 50,000 acres.

The present field of mud geysers is the reappearance of a similar field which existed prior to the lake's formation, though the area they now cover is larger the bubbling mud pots are much more numerous and more active. The report of the United States Geological Survey for 1902, for instance, mentions four "mud volcanoes" southwest of what was then Imperial Junction and is now known as Niland. They are explained in this report as fissures extending from subterranean bodies of steam, similar to those in Yellowstone Park, but not so active. The mud is created by the falling into this steam body of the fine silt forming the surface crust of the Salton Sink.

The reappearance of the mud geysers, made possible by the recession of the water from the area, after being submerged for about 13 years, occurred during the early part of 1918, presumably as an accompaniment to rather severe earthquake disturbances in the vicinity. A number of milder shocks have occurred since then, and during such times the geysers show a much increased activity.

New Lead-Burning Transformer for Storage Battery Work

THE most modern method of burning terminals in place on storage batteries, removing old connections, cutting off or building up posts, or in fact almost any form of lead work, is to do it electrically—by the electric welding process.

The last word in electric lead-burning equipment is shown in the accompanying illustration. The transformer of the set is designed to be connected to the ordinary 110-volt alternating current lamp socket, a 10-foot cord with plug being provided for this purpose. This attaching cord is protected by a special rubber covering against the hard wear, dirt, and acid with which it may come in contact. Connection to the transformer itself is made by means of a plug and socket connection so that this plug can be used in place of the snap-switch in the lamp socket for turning the current on and off.

Two separate rubber-covered terminal leads are used

Map of the Salton Sea showing the location of the mud geysers

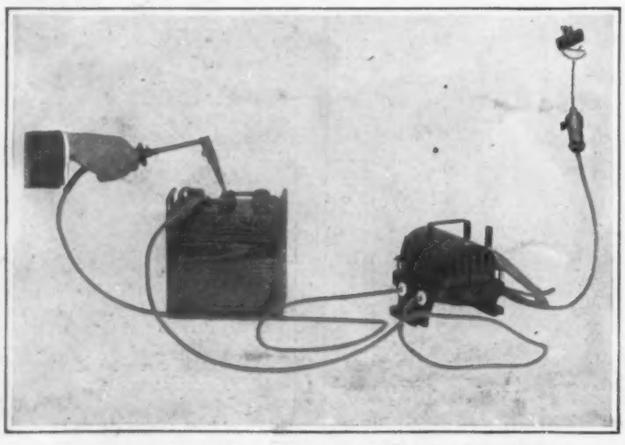
to convey the low voltage heat producing current to the parts of the battery to be welded. The lead having the large clip is fastened to the battery plate or post which is to be worked on. The other lead has at its end a carbon holder which is arranged with a heavily insulated handle so that the operator's hand is guarded from the heat. The carbon holder takes any ordinary arc welding carbon, this carbon forming the second terminal.

When the pointed arc welding carbon is brought into contact with the lead the pointed end of the carbon becomes intensely hot; so hot, in fact, that it melts the lead over a restricted area quicker than a pointed gas flame will do it. The welding or burning operation is carried out by a sort of puddling process, the carbon terminal being manipulated to flow the lead where it is needed.

Among the advantages of the electric lead burner is that repair work in hard-to-get-at corners can be done more easily as the heat is always right at the point of the carbon, the device is readily portable weighing approximately 25 pounds, joints do not have to be cleaned as the dirt and slag automatically rise to the surface of the molten lead and the surfaces are joined while cleansed. When properly used there is no glare to injure the operator's eyes, as he looks down on the cool end of the carbon in such a way that the bright point where the carbon touches the lead is hidden from view. There is no danger of electric shock because of efficient insulation.

On the basis of 10 cents per kilowatt hour, it costs about eight cents per hour for current when the device is operating steadily. The instant the carbon point is removed from the work, the current consumption practically ceases as the device takes then only 4½ watts from the line.

Owners of these transformers have found an interesting field of application. The device is said to be especially valuable to automobile owners in reconstructing and repairing storage batteries. In the shop and foundry it has been used where all kinds of odd soldering jobs must be done. The device has also been found applicable in plumbing, roofing, tank building, etc.



Burning posts on a storage battery with the new transformer

Classifying the Stars by Mendelieff's Law

THE stars are usually divided into six principal classes according to the spectra they exhibit, as follows: Class O, stars of the Wolf-Rayet type; B, helium stars; A and F, hydrogen stars; G and K, solar stars; M, oxide of titanium stars; N, carbon-containing stars, the class being determined by the preponderating substance, or at any rate, the most characteristic substance in the spectrum yielded by the light from the star.

It is now proposed according to a writer in the *Revue Scientifique* (Paris) to make Mendelieff's Law the basis of classification. This well-known law divides the elementary or simple substances into eight classes, each of which contains bodies with indisputably analogous properties. The following table shows the first three members in each class, the valence with respect to hydrogen being indicated by the numbers at the top:

4	3	2	1	0	1	2	3
—	—	—	H	He	Li	Ba	Bo
C	N	O	F	Ne	Ua	Mg	Al
Si	P	S	Cl	Ag	K	Ca	Se

Evidently it is quite feasible to place each star in that one of these eight classes which contains the element characteristic of its spectrum.

By analogy with the theory of Sir Norman Lockyer it may be accepted as true that the multivalent elements tend to dissociate progressively in proportion as the star increases in temperature. The maximum temperature occurs in the stars characterized by helium, an element whose valence is 0; then under the influence of a lessening temperature the atoms recombine and an increase in valence ensues.

The evolution of a star, consequently, proceeds from the right towards the left of the above table, the boron-aluminum group being the first member of this series of development, and the carbon-silicon group the final member.

Courses in Foreign Trade

DURING the current academic year, distinctively foreign trade courses have been given at a considerable number of our higher educational institutions, including Boston University, New York University, Columbia, New York City College, Georgetown University, University of California, University of Oregon, University of Washington. In addition to these, a considerably larger number of such institutions have offered some training in foreign trade subjects, but, generally, in connection with domestic courses in the same field.

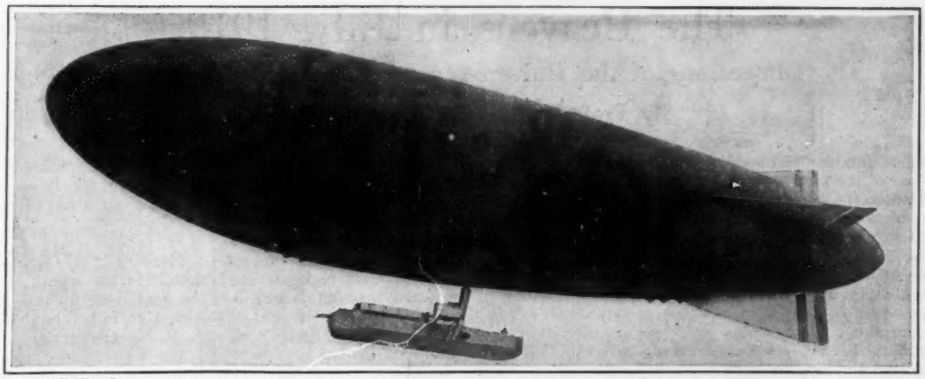
During the coming year a number of institutions have already indicated their intention of adding to such general courses as these a number of other courses of a distinctively more practical character, and at least two institutions are offering courses during the summer. These courses will be of interest not only to those who wish practical training for work in the foreign trade field, but likewise, to commercial teachers who wish to prepare for teaching such subjects.

A Dirigible Armed With a Cannon

WHAT may be considered another revelation of the great war is the dirigible shown in the accompanying illustrations. This dirigible, of the Zodiac type, was constructed for the American Army by a French builder of lighter-than-air type aircraft, and is armed with a three-inch quick-firing cannon, as shown.

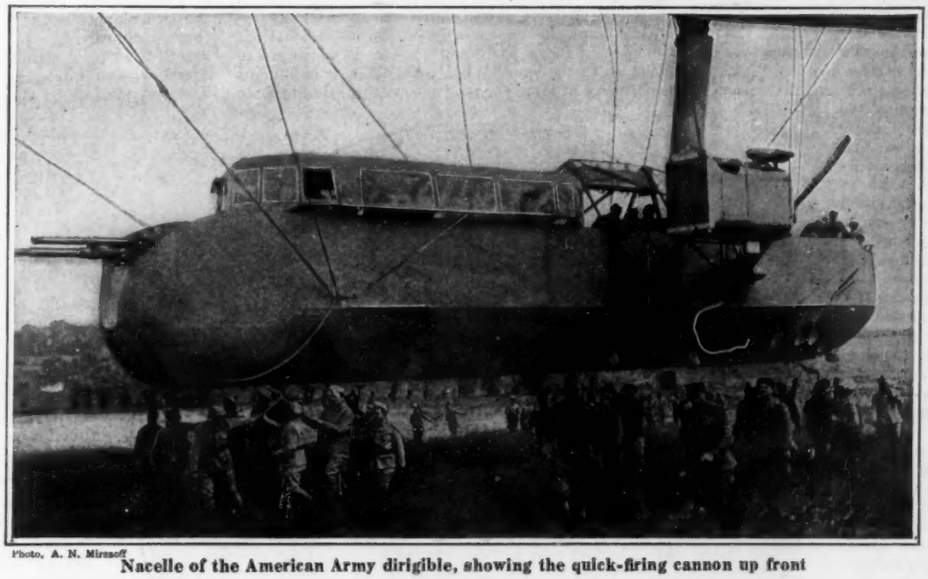
In the absence of definite details, the length of this airship appears to be about two hundred and fifty feet. The nacelle or car is said to be armored; at any rate, it is unusually roomy for a dirigible of such small size. The power plant consists of two engines, placed on either side of the fuselage, as shown in the second illustration on this page.

The cannon leads one to believe that this dirigible was intended for combatting large German dirigibles rather than airplanes.



Photo, A. N. Mirsaoff

Dirigible constructed by a French airship builder for the American Army



Photo, A. N. Mirsaoff

Nacelle of the American Army dirigible, showing the quick-firing cannon up front

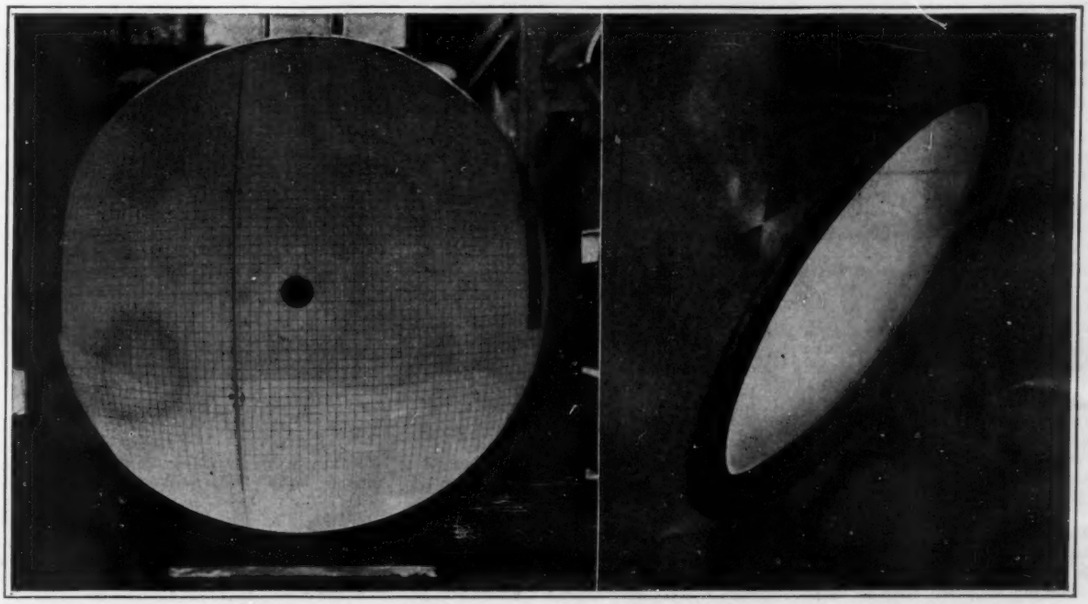
Parabolic Searchlight Mirrors

MEASUREMENT of metallic objects to ascertain their exact size and shape ordinarily takes a mechanical form. To be sure, it would usually be possible to find whether a metallic part were too large or too small by attempting to put it in the place provided for it, or by trying to use it for the intended purpose; but seldom would this process show just where and how great any discrepancy might be.

In the case of glass lenses and mirrors, however, the reverse is the case. These are intended to reflect or transmit light; and the reflected or transmitted light is visible. Moreover, it is visible not alone as a whole, but with reference to the rays that come from each point of the glass. We can see the glass work, and see just where and how great any discrepancy in its working is; it is possible to test the glass by actual performance.

This does not necessarily involve even removing the piece from its working position on the grinder or polisher. Thus, in the manufacture of the paraboloidal mirrors for searchlight, the mirror, if perfect, should transmit light to a focus on the other side just as truly as it reflects light in parallel lines after it has been silvered. So without taking the mirror from its place in the grinding machine, a beam of light is thrown through it. Then, to afford a quick and easy way of seeing whether this is properly focused on the other side, a smoke cloud is produced on that side of the glass and the whole transmitted beam of light is distinctly visible where it falls on this screen. This very elegant means of testing the performance of the mirror is shown in one of our cuts.

The other picture illustrates a second test which has to be applied to the searchlight reflector before it is accepted by the Government. A large carboard screen is ruled off in squares, and the network thus formed is viewed through the mirror. Any deformation of the lines, other than the slight circular bulging of the whole figure which our picture shows, indicates *and locates* a local fault in the grinding of the mirror. If however, a glass passes both the tests, it is satisfactory and goes at once to be silvered.



Testing a parabolic searchlight reflector. The ruled screen must be visible through the glass without local distortion; and a beam of light must reach proper focus in the smoke-cloud produced on the other side to make the test a visual one

Another interesting development which is to be seen in the shop at the foot of 116th Street, where many of the searchlight reflectors for the Government were made during the war, is a circular-parabolic mirror. The convex side of the big glass, which takes the metallic reflecting film, must of course be parabolic. But there is no particular reason other than custom why the inner one should be ground to a paraboloidal form. When it is so ground, the mirror is naturally of uniform thickness throughout; the same amount of glass is found near the center, where there is little or no danger of breakage, as at the edges, where this danger is present and has to be guarded against. Hence the mirror is very heavy, weighing at times several hundred pounds.

The new idea is to grind the inner, concave surface in the form of a spherical segment. The radius is so chosen that the edges of the glass are of the necessary thickness, while at the center the sphere approaches much closer to the paraboloid surface than before. This is feasible, because so much of the central segment of the paraboloid as is used for the mirror is flatter than a sphere of comparable size. Of course, if the two surfaces were extended beyond the circle that bounds the mirror, since the curvature of the circle remains constant while that of the parabola increases quite rapidly beyond the immediate vicinity of the vertex, the sphere would soon run through and outside of the paraboloid; but this does not take place within that circle. Under this scheme of construction, we have a glass which is of the usual thickness (an inch or more) at the edges, but which, in the center, runs off to a very small fraction of an inch. So great is the saving attained through thus shaving down the central thickness of the mirror that a 60-inch reflector made after this scheme weighs barely 70 pounds; two men, one at either side can move it about without knowing that they are lifting anything, and hence with no danger of accident.

Under-Water Storage of Logs

STORING logs under water will prevent blue stain, checking, insect attack and decay. (The logs would, of course, be subject to marine-borer attack in salt or brackish water along the sea coast where these pests are active.) Wood of any species completely submerged in water will resist decay indefinitely. Alternate wetting and drying, however, favor decay.

The Heavens in July, 1919

The Dimensions of the Universe, as Indicated by the Milky Way

By Prof. Henry Norris Russell, Ph.D.

AS we stand on a clear moonless summer night and face southward, we behold one of the most remarkable of celestial spectacles. It is not to the constellations of summer that this statement refers; they are indeed conspicuous, and contain many stars which are very remote and of great brightness; but even the most distant of the stars visible to the unaided eye form but the foreground to the greater picture with which we have now to do. It is the Milky Way which is, after all, the dominating feature of the summer sky. As we follow its mighty arch from the northern to the southern horizon we notice at once that in the northern heavens, in Perseus and Cassiopeia, it is relatively faint; that it becomes much brighter overhead, in Cygnus; and that to the southward, between Aquila and Sagittarius and in the latter constellation, it is extremely bright and full of clouds and patches of light.

A second, more careful, glance suffices to show that in addition to this brilliant stream of light, there is a second and fainter one, parallel to it and lying to the westward (or to the right, as we see it). Tracing the two back to the northward we find that they run together somewhere overhead, and that the northern Milky Way, though irregular in outline, shows no such double structure. If, at some other season of the year, we observe the part of the Galaxy which is now below our horizon, we find that it consists of a single stream of irregular breadth, relatively faint north of the equator in Auriga and Gemini, then brightening a little but remaining single to the southern horizon. In more southern latitudes, where the part of the Milky Way which is invisible to us can be seen, it is found that, on this side of the heavens too, it brightens up greatly in southern declination. Though in Orion and Canis Major it is relatively poor, in Argo it becomes brilliant, and this more conspicuous region extends on through Centaurus and the Southern Cross until it joins up with the bright region in Sagittarius. The two branches of the great stream of light, which are lost below our horizon in Sagittarius, remain separate for some distance farther south, but rejoin one another near the Southern Cross.

Considering the Milky Way as a whole, then, two facts stand out prominently. It is very much brighter on one side of the celestial sphere than in the opposite region; and it is split into two for about one-third of its whole extent, this division occurring on the side of heavens where it is brightest.

When seen from southern latitudes—for which alone the finest regions of the Milky Way, from Argo to Sagittarius, are fairly visible—their great superiority to the northern parts of the Galaxy is so plain that it seems remarkable that so little attention has been paid to this feature until within recent years. One cannot help asking questions about it. Why should the Milky Way be so uneven and why should it be split lengthwise the way it is?

The Center of the Universe

The answer to the first question is really almost obvious. The Milky Way looks much brighter in the southern heavens than in the northern because we are nowhere near the center of the universe of stars. Indeed, it looks from present evidence as though we were well out toward the side. Consequently when we look toward the center we see a great many more stars than when we look away from it, and the Milky Way appears correspondingly brighter.

This fundamental fact was first fully brought out by Shapley's remarkable investigations on the globular clusters, which indicate that the center lies in the general direction of Sagittarius, and that its distance is probably something like a hundred thousand light years. The reason why this was not realized long ago is that studies of the brighter stars—those visible to the naked eye, or visible in telescopes of moderate power—did not show any such lop-sided distribution. There are about as many of these in one part of the Milky Way as in another. It was therefore supposed that we were near the center of the "Universe," when the actual fact was that our explorations had not taken us out to the edges at all. The distance at which individual stars—even the brightest—will look bright enough to us to be visible to the naked eye is only two or three thousand light-years at most; and very few indeed of the stars which are visible in a small telescope can be as much as twenty thousand light-years away. But the distance to the limit of the "Universe" (that is, of the region where the stars are abundantly scattered through space) is greater than this, even on the side away from the center. All our soundings appeared to be equal, because they all should have recorded "No bottom" so long as they were made in the Milky Way. In other parts of the sky, where we can look obliquely across the relatively thin layer of stars of which our universe consists, we do strike bottom, and we find fewer telescopic stars, and even fewer visible to the naked eye, because we see clear through the star-sown portion of space into the vast void beyond.

But to do this in the Milky Way, when we are looking along the great layer of stars, and not across it, we must study the very faint stars, which are individually insignificant, but so enormously numerous that their combined light forms the great star-clouds which are so conspicuous to the eye. When we do this, it is obvious at once that we come near reaching bottom, if indeed we do not actually strike it, in the thinner parts of the Milky Way, in the northern sky—though to do so we must probably extend our investigations to a distance of thirty thousand light years or more. But in the opposite quarter, in the brilliant southern regions, no one knows whether we have struck bottom yet, although Shapley estimates the distances of some star-clusters as 200,000 light-years.

It begins to look as though in some places—notably the dark lane between the two branches of the Milky Way—we struck a false bottom. But an explanation of this must be deferred until next month.

At 12 o'clock : July 7.
At 11½ o'clock : July 14.
At 11 o'clock : July 22.

At 10 o'clock : Aug. 7.
At 9½ o'clock : Aug. 14.
At 9 o'clock : Aug. 22.

At 10½ o'clock: July 30.

The hours given are in summer months time.

NIGHT SKY: JULY AND AUGUST

The Heavens

As our map shows, the star-clouds in Sagittarius are now well visible, due south, and at their greatest altitude. Along the stream of the Milky Way, but in reality far nearer to us, appear the stars of the constellations Scorpio and Sagittarius in the south, Ophiuchus and Aquila higher up, Lyra and Cygnus nearly overhead, and Cepheus and Cassiopeia in the north. The eastern sky is dull, except for the great square of Pegasus. Capricornus and Aquarius, in the southeast, are inconspicuous. The western sky is better, with Virgo setting, Boötes above, then Corona and Hercules. Ursa Major, in the northwest, with Draco and Ursa Minor in the north, complete our list.

The Planets

Mercury is an evening star and is well visible in the middle of the month. He is farthest from the sun on the 18th, but, as he is moving southward, can be best seen a little before this date, when he sets about 9.50 P. M., summer time.

Venus too is an evening star, and reaches her greatest elongation on the 5th, when she is a little more than 45 degrees from the sun. She remains in sight until after 10.30 P. M., and is extremely conspicuous.

Mars is a morning star in Gemini, rising little more than an hour before the sun. Jupiter is in conjunction with the sun on the 20th, and is invisible. Saturn is an evening star in Leo, and sets at 10.15 P. M. on the 15th. He is in conjuaction with Venus on the afternoon of the 2d, the two planets being 10 minutes of arc apart, so that they can hardly be separated at a glance. Later in the month the ringed planet will be below Venus, but above Mercury, and might be mistaken for the latter by a hasty or uninformed observer.

Uranus is in Aquarius, and comes to the meridian about 4 A. M. Neptune is in Cancer, and is too near the sun to be observed.

The moon is in her first quarter at 11 P. M. on the 4th, full at 2 A. M. on the 13th, in her last quarter at 7 A. M. on the 20th, and new at midnight on the 26th. She is nearest the earth on the 23d, and farthest away on the 7th. During the month she is in conjunction with Venus and Saturn on the 1st—a pretty sight—with Uranus on the 16th, Mars on the 25th, Jupiter on the 26th, Neptune on the 27th, and with Mercury and Saturn on the 28th.

No news yet has come regarding the eclipse of last month, and it may be some time before the results are fully known.

Princeton University Observatory.
June 12, 1919.

The Current Supplement

THE study of earthquakes, their movements and causes has made considerable advance along lines of precise mathematical physics in recent years. This advance has been made possible by the interest eminent mathematical physicists of all countries have taken in the difficult problems seismology has developed. A review of these advances is presented under the title *Mechanics of Earthquakes* by the eminent Italian student Somigliana, in the SCIENTIFIC AMERICAN SUPPLEMENT for June 28th, 1919, No. 2269. Another eminent physicist furnishes us a very interesting article *Piezo-Electricity and Its Applications* wherein he shows how the slight piezo-current produced in a crystal of tourmaline which is suddenly subjected to great pressure may be—has been—employed in studying the details of explosion phenomena within gun or cylinder. The frontispiece illustrates types of dirigibles being built by the British government, and a very interesting general article sets forth clearly *The Different Types of Airship*, including those illustrated. The important results of certain war-time studies by the Forests Products Laboratory are revealed and demonstrated in the illustrated article on *Emergency Seasoning of Sitka Spruce*, while a very important discussion bearing on the economical and common-sense development of our inland commerce is discussed under *Economics of Transportation in the Mississippi Valley*. The account of the *Electric Propulsion of the "New Mexico"* closes with some details concerning her Main Control equipment. The third installment of Professor Bancroft's paper on *The Color of Water*, is presented; and there is described an ingenious improvement in the pattern of reflectors for street lanterns using electric incandescent bulbs, which secures continuity of illuminated area in place of alternate dark and bright stretches. Shorter contributions discuss *Winds and the Transatlantic Flight*, *Finding the Apparent Angular Movement of the Sun between the Solstices*, and the proper use of *Plywood in Airplane Construction*. The issue closes with the *Index to Volume 87*.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

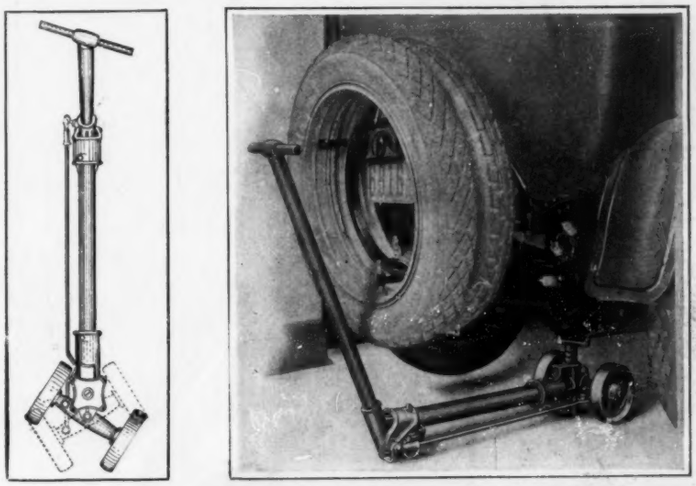
An Indoor Jack for Heavy Work

FOR quick action in shifting cars or trucks about in the garage, showroom, service station, tire shop, etc., there is need of a strong compact, easily operated, quick-acting, jack that will both lift and transport. The short construction of the jack illustrated is a big advantage in these connections; the length over all is but 40 inches, which enables the implement to be manipulated to good effect in cramped quarters.

Another distinctive feature is that the wheels of the jack pivot and are guided and controlled by the handle. By being able to cut the wheels to right and left, it is possible to gain a degree of quick handling and accommodation in crowded spaces which even the short construction of the jack alone would be powerless to give. This applies either to the manipulation of the jack alone, or of the jack when supporting a car.

The leverage is sufficient to lift 5,000 pounds with ease. The ratchet has a range enabling any car to be lifted high enough for any purpose with at most two strokes of the handle. The quick release latch provides for a rapid return to minimum height.

The jack is so designed that the weight of the load cannot throw the handle violently against the car. Although the handle is free and can be held in any desired position when the load is not being lifted or lowered, a light tension balance draws it, when under a load, into a perpendicular position which prevents it from protruding parallel to the floor.



The new jack in action, showing the short stroke of the handle, and a diagram showing the range of movement of its pivoting axle

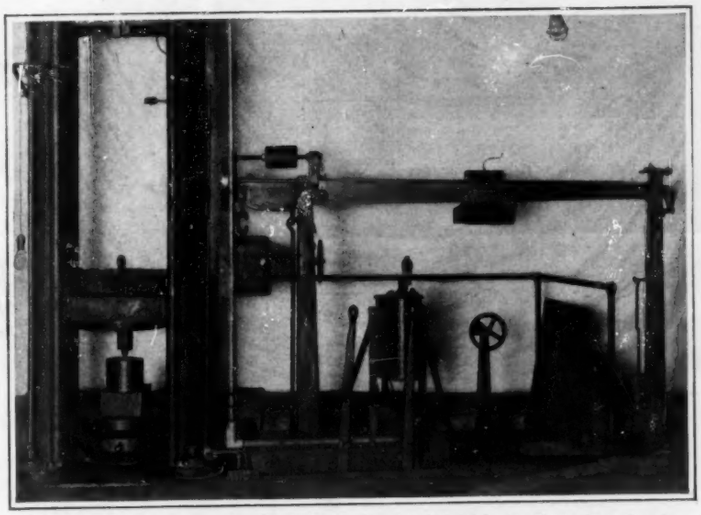
Sterilization by Pressure

IN a recent bulletin of the West Virginia University Agricultural Experiment Station, Prof. B. H. Hite and associates, Professors N. J. Giddings and Charles E. Weakley, Jr., present the results of a very large amount of work on "The Effect of Pressure on Microorganisms," together with the technique of high pressure experimenting in bacteriology. Summarized briefly the results are as follows:

No living thing has been found that could not be destroyed by pressure. Most bacteria, including those responsible for typhoid, tuberculosis and diphtheria, are killed in three minutes by a pressure of 75,000 pounds per square inch. Less time is required at higher pressures, more time at lower pressures; there is a fairly definite relation between the time and pressure, and having determined the time required to kill an organism at a number of widely different pressures, the intermediate time-pressure death-points may be interpolated with considerable accuracy.

Spores require much more severe conditions—higher pressures or much longer time under pressure. Spore forming organisms in the vegetative stage are easily killed, and sterilization may be accomplished by repeated brief applications of 75,000 pounds per square inch.

The above applies to room temperatures. Working at somewhat higher temperatures it would be expected that lower pressures would be effective, and this is true, but the explanation may not be as simple as it might at first appear to be, since the same is true of somewhat lower temperatures, the time-pressure death-point curves for 5 degrees C. and 40 degrees C. being practically the same. In sterilizing culture media etc., it has been customary to work at 40-45 degrees C., to apply a pressure of about 100,000 pounds at the close of the day's work and to find everything sterile and ready for work the next morning.

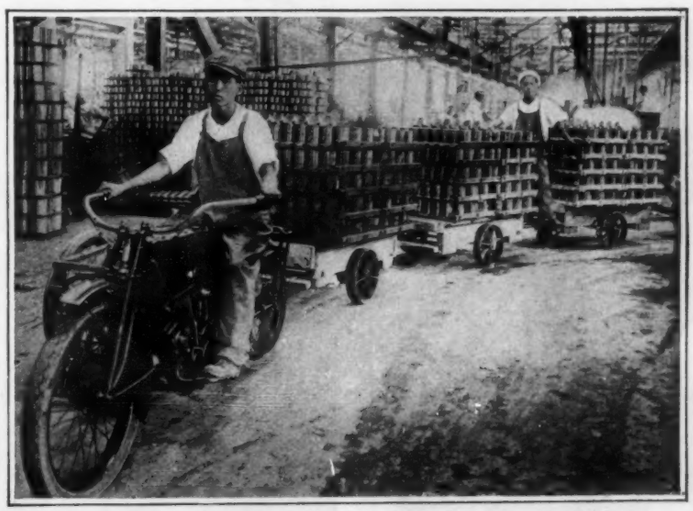


The machine for squeezing bacteria to death, set up in a testing apparatus to demonstrate that it will exert a pressure of 150 tons per square inch (not the limit of its capacity)

Working at 4-6 degrees C., a pressure of 75,000 to 100,000 pounds per square inch must be released or any water in the compressed material will be converted into a mass of soft ice. On releasing a pressure of 200,000 pounds at room temperature water is frozen hard Most other liquids contract on freezing, so freeze at higher temperatures when pressure is applied. Comparatively low pressures were found to be sufficient to freeze many liquids and the use of high pressure in obtaining low temperatures is suggested. Solid chloroform melting at 70 degrees C. was easily prepared.

The high pressure equipment used by Professor Hite and his associates is very simple and easy to construct. A high pressure cylinder may consist of a block of steel with a hole through it, the hole being closed at either end by steel plugs one of which is long enough to serve as a piston. The liquid to be compressed is completely encased in a lead (or other soft metal) packing which consists of a piece of lead tubing both ends of which are closed with lead lids. The pressure is applied to the packing and its contents. There are no leaks. The pressures obtainable are limited only by the strength of the cylinder and piston. Cylinders intended for very high pressures were built up of several concentric cylinders shrunk together and thoroughly stretched by applying higher pressures than were to be regularly used.

The picture shows one of the high pressure cylinders set up in an Olsen testing machine. The inside diameter of this cylinder is 0.662 inch. A 16-inch gun built on the same proportions would be more than 14 feet across the breech. Incidentally the piston is supporting a load of 52 tons. The piston is supported by a column of water. The cylinder had been used many times at higher pressures. But this test was made and the picture taken by some doubting engineers who were satisfied with 300,000 pounds per square inch.



The motorcycle as an indoor tractor

The Motorcycle in the Factory

THE motorcycle is here seen in a Hawaiian pineapple cannery, used as a heavy hauling unit or baby tractor. The gearing is in the ratio of 26 to 1 in low gear, 16 to 1 in intermediate gear and 10½ to 1 in high gear.

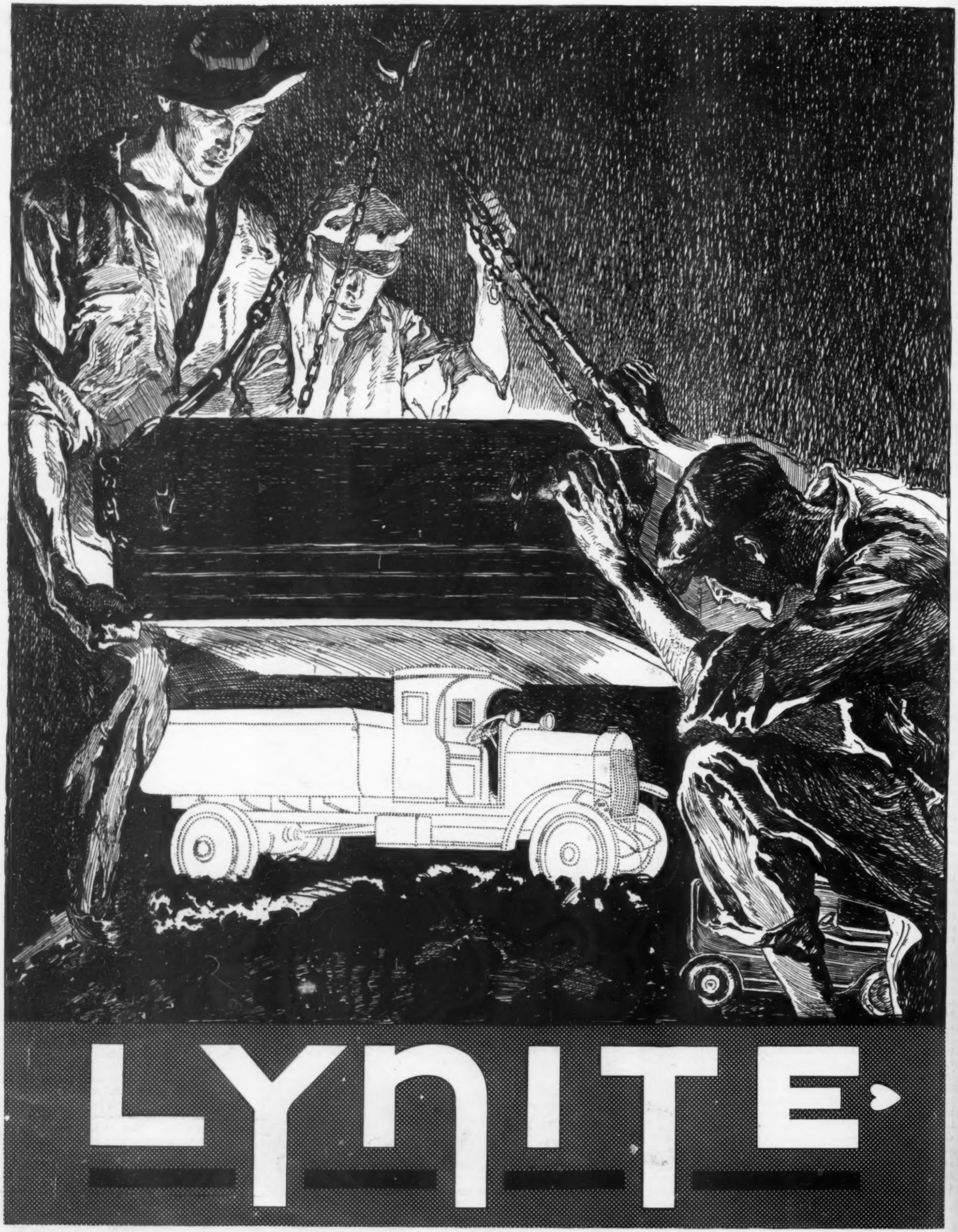
The hauling capacity is four and half tons to a trainload of four cars each. It is figured that the pines are moved from the cooling floor to the warehouse, a distance of one-fifth of a mile, at the rate of two and one-half cents a ton. Three machines are in use at the cannery, hauling from ten to eighteen cases of pineapples a day.

Latest Patent Decisions

THE two patents here involved concern the construction of a tin cap, at the top of a yearly calendar pad, which by engagement with slot in a permanent backboard holds such pad in engagement with the backboard. The court below found the patents valid and infringed.

The case turns on validity, and the court adds nothing to the reported case by a further discussion of details. The question of inventive character of plaintiff's tin cap was one of fact. A permanent, slotted back, on which a new

(Continued on page 701)


LYNITE

Remolding the Motor Truck

Part by part, piece by piece, *Lynite* foundries are remolding motor truck and motor car to new standards of liveliness and ease of handling, of gasoline and tire-saving.

Part by part, piece by piece, pounds or ounces are being cut from costly excess weight—pounds from the bigger parts such as cylinder-blocks, ounces from the smaller ones such as hub-caps and pedal plates.

For the automobile industry has found that no casting on a motor truck or motor car is too big to be made of *Lynite,* no piece too small to be worth making lighter through its use.

Yesterday automobile dealers looked dubiously upon efforts to make of *Lynite* a few such parts as crank-cases.

Today more than seventy different car and truck parts are made of it, one car alone containing 48 different pieces.

And to the automobile world today *Lynite* no longer means those parts presenting comparatively simple metallurgical and foundry problems.

It means the whole external structure of the engine—from cylinder-head to oil pan. It means the heart of the engine—the pistons. It means entire bodies. It means in a word, practically every part for which heavy cast-iron was once the accepted metal and still others that were formerly of steel, brass, wood or other material.

Lynite today is reducing the weight of motor cars from 300 to 500 pounds—not alone by getting rid of scores at one sweep from the larger parts, but by trimming off an ounce or two here, an ounce there from a multitude of smaller ones.

What is the explanation of this progress? For this you must look not alone to the tremendous strides which *Lynite* Laboratories and *Lynite* Foundries have been making—and are still making—in extending the use of *Lynite* to more and more applications in the truck or car. You must look as well, to the readiness of motor truck and motor car builders to meet the ever-increasing public demand for weight-economy and all that it means.

Together they presage the coming of that day in the not distant future when the truck or car with a cast-iron part will be as out of date as is the one of today without electric lights.

THE ALUMINUM CASTINGS CO.
Lynite and *Lynux* Castings
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Lynite is Used for These 70 Different Truck and Car Parts

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Accelerator Pedal Plate
Body
Breather Body
Breather Cap
Bearing Caps
Cylinder Block
Cylinder Head
Cylinder Head Cover
Cowl Board
Carburetor Body
Crank Case
Clutch Cone
Dust Cap
Door Bumper Socket
Door Handles
Differential Carrier
Differential Carrier Cover
Engine Support Brackets
Foot Rest Bracket
Fan
Fan Pulley
Fenders
Floor and Toe Boards
Flywheel Housing
Fan Support Bracket
Filler Cap (Gas)
Generator Bracket
Governor Casing
Governor Casing Cover
Hot Air Stove
Hub Caps
Hood
Intake Manifold
Oil Pump Body
Oil Pump Body Cover
Oil Pressure Regulator Body
Oil Strainer Body
Oil Filler Body
Oil Filler Cap
Oil Pan
Oil Gauge Body
Oil Reservoir
Oil Reservoir Cover
Pistons
Pedal Floor Plate
Radiator Guard
Radiator Header—Upper
Radiator Header—Lower
Radiator Shell
Rocker Shaft Support
Steering Wheel Spider
Steering Column Cowl Bracket
Spark & Throttle Lever
Spark & Throttle Sector
Steering Gear Housing
Transmission Case
Transmission Case Cover
Thermostat Body
Throttle Lever
Timing Gear Case Cover
Valve Lifter Rod Cover
Water Pump Cover
Water Pump Body
Water Pump Outlet Elbow
Water Pump Support
Water Pump Support Caps
Water Inlet Pipe
Water Outlet Pipe
Worm Gear Carrier
Worm Gear Carrier Cap

LYNITE

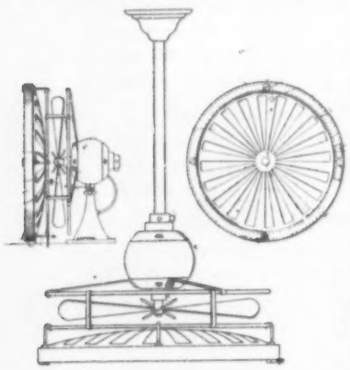
Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Electrical Devices

BATTERY ADAPTER.—M. H. SMITH, 5427 Angora Terrace Philadelphia Pa. The object of the inventon is to provide a battery adapter, for use in flashlights, and similar electrical apparatus and arranged to accommodate at least two battery cells each adapted to be removed when played out to permit of substituting a new one. Another object is to provide automatically an electric connection between the battery cells and to insure a connection between the adapter and the electric lamp and switch.

DEFLECTOR FOR ELECTRIC FAN.—R. C. WHITE, 901 Florida Life Bldg., Jacksonville, Fla. The invention has for its object to provide a deflector which may be used in connection with electric fans of various types whereby the direct



DEFLECTOR AS ADAPTED TO CEILING AND ORDINARY TYPE OF FAN

breeze created by the fan may be broken up and distributed. The device is so constructed that it may be attached to fans already in use, it may be used in bed rooms or hospitals without harmful results, in offices without disturbing papers, etc., on desks, or as ceiling fans for large areas.

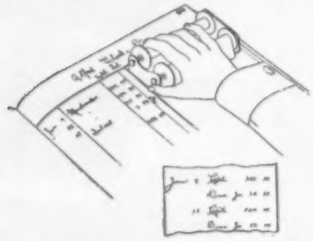
Of Interest to Farmers

GRADER DRAG PLANE.—H. H. THURSTON, Anoka, Minn. The invention has for its object to provide a device of the character specified, by means of which a road may be cut or scraped to the proper inclination and the superfluous soil moved to the side wherein the inclination of the blades is varied by shifting the frame and wherein all wheels, gears, and levers are eliminted.

ROTARY DRILLING OR SOWING MACHINE.—C. E. P. JULIEN, 1 Avenue de l'Observatorie, Paris, France. The invention reates to a machine for all kinds of seed or manure, in continuous or discontinuous lines, with a rational compression of the seed. It is characterized by a circular rim in the form of a disk provided with pins, the said wheel rotating about an axle which supports, by means of a frame, a seed or manure hopper, communicating with a detachable tube which conveys the seed either to the front or back of the rim.

Of General Interest

BOOK POSTING DEVICE.—E. VARLEY, care of Standard Bank of So. Africa, 10 Clements Lane, Lombard St., London, England. The invention has for its object to provide a book-posting device having two rollers spaced apart, a tough, absorbent paper being rolled on one roller



VIEW ILLUSTRATING HOW DEVICE IS USED, AND FAC-SIMILE OF AN ENTRY AS SEEN THROUGH REVERSE SIDE OF PAPER

and having an end secured to the other so that the paper may be rolled thereon, the paper being disposed under a plate between the roller to permit the plate when the device is used to press the paper against a ledger entry, thereby blotting and at the same time recording the entry in such manner as to permit the bookkeeper to ascertain if the sum agrees with the entry book.

PORTABLE FOLDING BED.—R. H. MCCUNE, Roswell, N. M. An object of the invention is to provide a folding bed made in such a way that it can rapidly be taken apart, and rolled into a comparatively small compass, made

A PERSPECTIVE VIEW, SHOWING ONE APPLICATION OF THE BED

of light and yet strong material, and including a tent cover as an accessory so that the bed may be used more particularly for camping, and that can be readily carried about in a conveyance, as for example an automobile where it will take but little room.

BINDER.—F. H. CRUMP, 225 E. 4th St. Los Angeles, Cal. This invention relates more particularly to transfer binders in which loose leaves are permanently stored. Among the objects is to provide a binder which will avoid the necessity of an adjustable clamping member or an unsightly threaded post with a nut, or to bend a flexible post to secure the proper adjustment, to provide a binder with no protruding members which will mar the furniture.

Hardware and Tools

TOOL.—W. H. WILSON, Tulsa, Okla. This invention has for its object the production of a device consisting of sections movable toward and from each other especially adapted for connecting a scrubbing brush, mop, sand block or the like to a handle in such manner that the utensils may be interchanged, and may be used with the same handle.

TOOL.—W. F. GANNON, Box 73, Parkman, Wyo. The invention has for its object to provide a tool especially designed for use in building wire fences. The tool comprises a pair of handle members pivotally connected at one end, one of the members having a claw extension beyond the pivotal connection, and both members having a pair of cooperating jaws at each side, the outermost jaws having rounded recesses for receiving the wire to permit the wire to turn and slip, the handle member not having the claw being provided with notches for engaging the wire.

Machines and Mechanical Devices

BALL BEARING.—J. NEWMANN, 212 Wyckoff Ave., Brooklyn, N. Y. The invention relates particularly to ball bearings of the class in which cages are employed for holding and separating the balls. The principal object of the invention is to provide a construction of a cage which can be used for a single, double or multiple ball bearing.

LIFTING TRAP.—G. R. CARTER, Oklahoma, Okla. The invention relates to liquid distribution mechanism. An object is to provide a lifting trap for transferring water, oil, or other fluids against any pressure to any height or distance, and in any desired volume, by means of air or steam pressure through the cooperation of certain float controlled mechanisms. Another object is to provide a lifting trap including a plurality of fluid level controlled floats governing the action of certain trigger devices for releasing the master valve shifting float.

CLOTH RENAPPING AND REFINISHING MACHINE.—E. J. DUNKLEE, 309 Lookout Ave., Hackensack, N. J. The general object of the invention is to provide a cloth napping machine for renovating garments, the device embodying a table on which the garment can be held in stretched condition for enabling the napper, cutter, and presser to operate effectively, the table embodying a board and coacting spring-closed jaws for holding the article in a smooth condition; the napping implements are adapted to be connected one at a time with a motor through a flexible shaft.

AUTOMATIC TWYER CLEANER FOR METALLURGICAL CONVERTERS.—C. J. ARCH, 806 G Ave., Douglas, Ariz. The invention relates to twyer cleaners especially designed for converters whereby the twyers can be quickly and effectively cleaned automatically after the apparatus is once in operation by the attendant. The device is so designed as to constitute an attachment for converters of standard design without changing the construction thereof and without interfering with the turning of the converter.

Musical Devices

AUTOMATIC MAGAZINE PHONOGRAPH.—E. ARMBRUSH, Gillies Depot, Ontario, Canada. Among the objects of the invention is to provide a self-contained cabinet or casing of compact form and convenient size, adapted to carry in operative position a considerable number of selected records with means for bringing any or all of the records into playing position, the device being fitted with automatic selector and stop so arranged that the machine will play any selected group of records one after another and stop at the end of the last record.

POST CARD.—S. E. STOUT, 220 Golden St., San Francisco, Cal. This invention has particular reference to a card on which sounds may be recorded and answers reproduced. An object is to produce a card having a portion thereof provided with a record receiving surface, and after having a record groove formed in the surface, may be safely forwarded by post. Another object is to provide means in connection with the post card and recorder for guiding the stylus of the latter.

Prime Movers and Their Accessories

CRANK CASE OIL TRAP.—L. R. POSCHADEL, 155 Garfield Ave., Milwaukee, Wis. This invention relates to internal combustion engines and has for an object the provision of a construction for the crank casing whereby the lubricating oil therein is continually trapped regardless of the position of the engine. A further object is in the crank casing, a trap arranged to receive the oil as the engine moves from a horizontal position and to maintain the oil until the engine moves back to its correct horizontal position.

ROTARY ENGINE.—S. E. KOCHENDARFER, 58 N. Main St., Washington, Pa. An object of this invention is to provide a rotary engine having no dead center, thus permitting the engine to start up and run, no matter where the oscillatory pistons happen to be with respect to the steam chamber. A further object is to provide spring pressed oscillatory pistons which are normally held in operative position, and to provide means for rendering the device steam tight, that is to say, for preventing the passage of steam between the edges of the oscillatory piston and the walls of the steam chamber.

Railways and Their Accessories

RAILWAY CROSSING.—L. RYAN, 4240 Macpherson Ave., St. Louis, Mo. The invention has for its prime object the purpose of reducing to a minimum the pounding and jar incident to crossings of street railways. The invention provides an elevation at the distant side of the flange groove and a bevel or incline leading to the elevation, the arrangement being such that before the tread of a crossing wheel leaves the rail at one side of a groove, the tread of the wheel at a forward point thereon will contact with the incline leading to the elevated tread surface of the track.

Pertaining to Recreation

GAME.—N. E. KNALL, 1084 Mt. Vernon Ave., San Bernardino, Cal. The invention relates to a game board and pieces, of which the playing field is in the form of a swastika made up of parallel longitudinal and transverse intersecting lines having openings adjacent the points of intersection for the reception of the pieces. The game may be played by two, three or four players, and in case of four players they may play as partners or individuals.

AMUSEMENT APPARATUS.—E. S. DOUGHTY, 417 Fourth St., Red Wing, Minn. The invention has for its object to provide in apparatus of the character specified, a trackway and a series of vehicles adapted to move upon the trackway, the trackway being formed like a stairway, consisting of a series of sets of treads, and the vehicles being so shaped that they will rock forwardly and rearwardly as they move over the treads.

TOY MACHINE GUN.—F. V. DUPONT, 808 Broome St., Wilmington, Del. The invention relates particularly to a continuous rapid-firing toy gun, the object being to provide a device of this nature which will be durable, and in connection with which considerable range may be given the discharged bullets, and guns of different ranges readily constructed along the same lines.

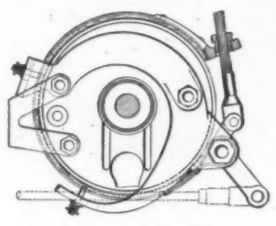
Pertaining to Vehicles

AXLE HOUSING CONSTRUCTION.—D. C. GOFF, 2331 Washington Ave., Knoxville, Tenn. The object of the invention is to provide a housing for a load axle and a live axle in one unit, thus attaining light, weight, compactness and strength. In this invention the housing consists of a hollow portion for the live axle, and a solid portion for the load axle, the solid portion having sockets at its ends for receiving the spindles of the wheels, and the spindles are secured within sockets in any desired manner.

AUTOMOBILE SEMAPHORE.—W. J. HENRY, 868 Kenyon St., Akron, Ohio. This invention relates to a signal whereby to warn adjacent vehicles and pedestrians of the driver's purpose to stop, turn to the right or left, or go ahead. An object is to provide a semaphore, the movements of which may be effectively controlled from a single point to operate the signal at opposite sides of an automobile, irrespective of the means employed for lighting the signal, whereby they may be visible at night.

SELECTIVE CONTROLLING MECHANISM.—C. F. MARSTON, 2330 Tilden Ave., Brooklyn, N. Y. This invention relates to selective controlling devices for automobiles and other machines; the object is to provide controlling mechanism arranged to enable the operator to readily actuate the gear shifting or the brake mechanisms through the agency of a single pedal thus leaving the hands free for other work. Another object is to permit of applying the controlling mechanism to devices without requiring altering their construction.

EMERGENCY BRAKE.—F. J. BOSEK, 91 Germania St., Galeton, Pa. The invention relates to a brake device especially adapted for Ford cars, its general object is to provide a substitute brake construction whereby the brake



A SIDE VIEW OF THE DEVICE

band will engage externally the brake drum so as to secure greater reliability and holding power, supporting means being applied to the stationary disk associated with the brake drum for holding the brake band and the toggle device for contacting the brake band into frictional engagement with the drum.

Designs

DESIGN FOR A SUPPORTING PLATE FOR A HOSE- SUSPENDER.—C. J. HAUSEN, 368 W. 50th St., New York, N Y.

DESIGN FOR A FLAG.—F. A. WATERHOUSE, 266 Humphrey St., New Haven, Conn. This ornamental design shows a combination flag. The flags of United States, England, France and Italy are surrounded by the flags of twenty-seven other nations, representing the world defenders of liberty, justice, righteousness and honor.

DESIGN FOR A BANNER, FLAG, PENNANT, SIGN, EMBLEM OR ARTICLE OF A SIMILAR NATURE.—L. A. AMES, care Annin & Co., 99 Fulton St., New York, N. Y. The design is a "welcome home" banner, consisting of a white field with red border, a green wreath branching from a shield of red, white and blue, and a blue star between the terminals of the wreath.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

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On top of these savings, the powerful Goodyear Cords are promising to rival or even surpass the mileage delivered by solid tires in the same service.

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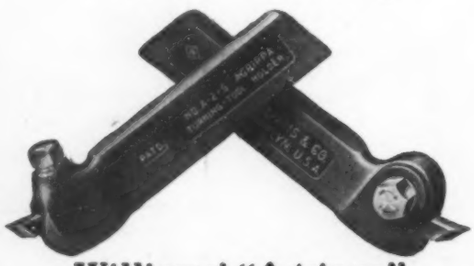

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Thirty Million Years Ago

(*Continued from page 685*)

The Burgess fauna of Walcott shows that the pre-Cambrian invertebrates invested all water areas and became completely adapted to all life zones of the seas, except possibly the abysses. The varied orders of the seas we know today were there. The orders that left the seas for land and air were there. But the main question still remains problematical. Which one of these great invertebrate divisions was it that gave rise to vertebrates?

Ordovician time, the early Paleozoic Epoch next above the Cambrian, is the period of the first vertebrates known. Walcott found near Canon City, Colo., the fossil remains of fish dermal defenses. Subsequently he discovered in the region of the present Bighorn Mountains of Wyoming and the Black Hills region of South Dakota, small spines referred to sharks, also abundant at Canon City. Since they were slow moving types protected with the beginnings of a dorsal armature composed of small calcareous tubercles, to which the group name Ostracodon refers, probably these earliest known pro-fishes were not primitive in external form, but followed upon a long antecedent stage of vertebrate evolution. But of the armored Ordovician ostracoderms, very little is known. It is in the later Upper Silurian that we obtain our first glimpses of North American land life in the scorpion spiders, the oldest known air-breathing animals, and also of the first known land plants.

Thus Walcott must be credited with having set up the whole panorama of first life on earth, with actual fossil specimens of the creatures from which later insects, the pro-fish, then true fish, then reptiles, then birds, and then mammals and man arose.

Osborn's investigation of the first appearance of plant life on earth carries back considerably before the above mentioned animal forms saw light. He states:

"Algae are probably responsible for the formation of the very ancient limestones. Those of the Grenville series at the very base of the pre-Cambrian are believed to be over 60,000,000 years of age. The algal flora of the relatively recent Algonkian time, according to Walcott, together with the calcareous bacteria, developed the massive limestones of the Belt mountains of Montana. We are now beginning to see where the magnesia of the limestones comes from, and the algae are probably the most important contributors of that constituent.

"The Grenville series of rocks at the base of the Palaeozoic is essentially calcareous, with a thickness of over 94,000 feet, nearly eighteen miles, more than half of which is calcareous, according to Pirsson and Schuchert. Thus it appears probable that the primordial surface continental waters swarmed with these minute algae, which served as food for the floating Protozoa, one-celled animal forms."

British Textile Industries as Affected by the War

(*Continued from page 684*)

possible if unrestricted competition by agents of all the Allied governments had been permitted.

Whatever goods were purchased for the Allies have been provided at the same prices and on the same conditions as for the British government; and, although this policy may have considerably restricted the freedom of the British manufacturer, it has had important results in getting the best out of the industrial organization of the country. The tendency to concentrate in one hand the buying for the Allies from British industries—at least from the staple industries—has become more pronounced from year to year, owing to the ever increasing stringency of all essential raw materials.

This shortage of materials, in connection with the pressure on machinery and labor, has had an important result. It was found that the varying specifications of the several British departments and of the Allied nations for certain goods were the cause of a disproportionate demand on machinery and material. Where the total requirements came too close to the maximum output, this retarded production and made it impossible to provide all that was required. Complete standardization of pattern is of course impossible of realization; but long steps have been taken to limit the variety demanded. In pursuance of this object, the specifications of the Allies as well as those of certain British departments underwent important modifications. This was particularly the case in the woolen industry, where the changes effected have materially simplified the application to the orders of Allied governments of the British requisition system of purchase, and the issuance, against such orders, of materials from the common stock.

The system of joint purchase has also been extended to certain raw materials obtained from abroad. Supplies of jute and jute goods for the Allies have for some time now been bought under the arrangements mentioned. Italy obtains Indian hides, of which she needs some four million per year, by leaving the purchase in British hands. Manila hemp for France is secured similarly; and the Allied requirements in certain foodstuffs are also purchased jointly. Conversely, Britain's requirements of raffia are purchased on her behalf by France. Finally, in purchasing the Colonial clip, the British government provides supplies both for itself and its Allies.

Generally speaking, the system of joint purchases has effected considerable economies of money, labor and material. It has revealed unsuspected capacity on the part of British industries. Perhaps most important, it has reduced Allied dependence upon neutral countries, and provided goods for all the Allies on the same advantageous terms enjoyed by the British government.

War-Time Construction in the French Naval Arsenals

(*Continued from page 686*)

being assembled for the "Gascogne" at Fives-Lille, which fell into the hands of the Germans when the latter overran the northern provinces. The construction of the "Bearn" had to be interrupted before she could be launched, but work on her hull was resumed in 1917 in order that the slip she was occupying might become available for merchant marine.

The four 30,000-ton dreadnoughts of the "Tourville" class, projected before the outbreak of hostilities, which were to have been laid down in the spring of 1915, were never begun in view of the difficulties experienced in completing the ships already under construction.

Another important branch of construction work was the building of 25 submarines, which were added to the French navy. With the exception of the "Gustave Zede" (which was commissioned in October 1914) and the "Nereide" (on account of the difficulty of obtaining the delivery of her Diesel engines, this submarine was temporarily commissioned as a "defensive submarine" only) the construction of all these submarines was interrupted by the outbreak of hostilities and not resumed for over six months. The "Nereide," "Ariane," "Andromaque," "Daphne," "Cornelie," Dupuy de Lome," "Sané," "Artemis," "Arethuse," "Atalante," and "Gorgone," were completed in 1916, the "Diane," "Clorinde," and "Bellone" in 1917, and the "Amphitrite," "Astree," "Amarante," "Hermione," "Lagrange," and "Romazzotti" in 1918. Only the "Joessel," "Fulton," "Laplace," and "Regnault," whose entry into service was delayed by the non-delivery of their engines, remained incompleted on November 11th, 1918.

By exercising its right of pre-emption, the Ministry of Marine was able to acquire three submarines of the "Laubeuf" type

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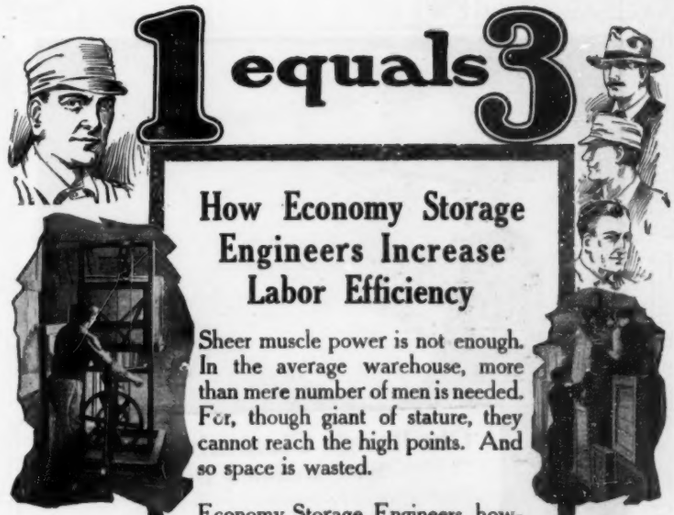
Lake Michigan's Encroachment on Its Coast

(*Continued from page 687*)

extremely rapid in comparison with the rate at which seas usually destroy their coasts. This high rate of destruction is accounted for by the kind of material washed away, and its low power of resistance when attacked by waves. Compare the work of the lake's waves north of Chicago with that of the Atlantic Ocean at Gloucester, Mass., or of the Pacific Ocean at Cypress Point, Cal. The lake has penetrated miles into the land while the oceans have progressed only rods in the same time; but the seas have worn away cliffs of hard, solid rock, a foot a century, perhaps, while the lake has encountered only loose soil. One might watch the Atlantic's waves pounding for months at Gloucester and never see a fragment the size of a man's hand loosen and fall; but when waves strike against the bluffs along Lake Michigan's shore, the soil breaks loose and falls by the wagon load, and the phenomenon may be observed any stormy day when shoreward winds drive the water violently.

Therefore, the makeup of the land along the lake's western shore is interesting, in the district under consideration. The soil consists of clay, sand, gravel, and boulders, all deposited by ice during the Glacial Age. Most of it was brought down from the north on moving ice, floating on water or pushed forward over the land. Part of it undoubtedly came from Canada, several hundred miles distant from its place of deposit, but other was scooped up as the moving ice crossed Wisconsin, as may be learned from an examination of the material. The ice sheet was hundreds or perhaps thousands of feet thick, and was laden with earth and stones. It progressed little farther southward than the southern end of Lake Michigan. There it melted during many centuries, and its load of earthy material was dropped, forming a layer from 100 to 200 feet thick. This transported material is now the land and the soil of the region, and it constitutes the banks and bluffs which the waves are now beating down and washing away. Steadily during thousands of years the waves have been at their work, and have advanced inland from three to eight miles along a coast line of 150 miles.

At few other places in the world can similar phenomena be studied to equal advantage. The process which has been active during so long a period is continuing with such rapidity under the very eyes of the observer that he may sometimes note the changes from day to day. Trees on the brow of a 50-foot bluff today may be in the water next week with all their branches, roots, and adjacent soil. A dashing rain gullies the raw front of a bluff, cutting channels in the non-resisting glacial clay and washing down tons of



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material and placing it within reach of the waves which speedily carry it away.

Wingwalls and breakwaters have been built at strategic points along the shore to check this destruction. Some of them are built by private parties to protect their lands which front on the lake; others are the work of clubs, companies, associations, and municipalities for a similar purpose. The lake shore northward from Chicago nearly or quite to Milwaukee is covered with magnificent private estates, club houses and grounds, golf courses, schools, manufacturing plants, hospitals, orphanages, towns by the dozen, government property, including Fort Sheridan and the Naval Training Station at North Chicago.

The continued advance of the lake into the land is destroying or imperiling much of this valuable property. In consideration of that fact the lake's activities cannot be viewed lightly. It mattered little or not at all in the long ago when the only human inhabitants of the shore were the savage Indians who could easily move their camps farther back when the caving banks threatened to precipitate them into the lake. The millionaire who owns the land now cannot move back as the waves approach, and he builds breakwaters to protect his property.

Calculations, which make what seem to be reasonable allowance for uncertainties concerning the average depth of the land which has been washed away by the lake during the past four or five thousand years, show a yearly average of 7,000,000 tons of soil that has gone into the lake and disappeared from the 150 miles of shore north of Chicago. The 600 square miles of land would equal a cube 12,000 feet on the side, amounting to several cubic miles. The annual toll of 7,000,000 tons is an enormous quantity to sink from sight beneath the water every year, and its final destination excites interest. Six hundred square miles of land are not easily hidden. Most of the burden is soft, extremely fine material that was ground to rock powder by glaciers in their slow journey from the north long ago. But mixed with this finely-ground material are occasional streaks of gravel, rocks, and large boulders which were dropped when the ice that carried them was melted. These may be seen protruding from the face of the bluff along the water front. As the hand wears away the boulders roll into the lake where they rest, because the currents are not strong enough to move them. A few large boulders lie strewn over the country where they were evidently dropped from icebergs floating over when the region was covered by water. One such boulder, weighing probably 150,000 pounds, lies near the railroad station at Waukegan, Ill. Thousands of its fellows repose on the lake bottom off shore, and such are particularly numerous off the town of Winnetka, where they mark the position and direction of a former glacial moraine which the lake has destroyed by its encroachment. The remaining stub of this moraine forms the lake bluff at Winnetka, and the extreme end of the stub is occupied by the municipal water tower at that place. Piers and walls, erected as breakwaters, have checked the lake's encroachment at that point.

The billions of tons of material washed from the long shore line during the past 4,000 or 5,000 years, have not been wholly lost from sight. Doubtless much of it lies spread on the bottom of the lake in deep water beyond the old submerged shore line; but vast quantities have been carried southward by waves and lake currents and have been thrown upon land in northern Indiana and southwestern Michigan. Wind has carried the sand and dust inland, some of it many miles from the present shore. The sand hills, dunes, and ridges which form so conspicuous a part of the landscape between Gary, Indiana, and Michigan City, and beyond, are built of this material. Some of the hills are from 100 to 200 feet high, and miles in extent. The finely-powdered sand is driven before the wind in such quantities as to bury forests in some localities, and cause truly desert conditions.

The lake's waves still pound the shores. The agencies which have done so much in the past are still active. Currents and winds move as formerly, and the spoils are thrown upon the beaches of the lake to be transported inland by the wind; but the worst of the destruction is over, because breakwaters and shore defenses will finally put a stop to the lake's encroachment upon its western shore, and the sand hills in southwestern Michigan and northern Indiana will cease growing for want of fresh material.

Amateurs in Name Only

(Continued from page 689)

but a few dollars for an entire receiving set!

While some apparatus of the inexpensive category is now being made, for the most part the manufacturers have gone on to what is practically commercial equipment. Where an instrument used to cost three dollars, it now costs ten; where a complete receiving set used to cost $20, it now costs $100. But there is as much difference between these sets as between a "one hoss shay" and a powerful automobile.

Wherein Nothing but the Best Will Do

Nothing serves better to illustrate the type of instruments and sets now being produced for and purchased by the amateur, than some of the accompanying illustrations. The mechanical and electrical improvements that have been carried out are evident at a glance to those familiar with pre-war equipment. No longer is wood acceptable for mounting the metal parts and handles, and even hard rubber with stamped figures and indicators will not pass muster with the critical amateur. Instead, the panels of the instruments must be of bakelite with the lettering and graduations carefully engraved. The bakelite is hand rubbed, giving it a smooth, satin-like finish. The metal parts are finished in black oxydized brass and white nickel. The knobs are large and carry dials which turn past a marker, instead of the old practice of carrying an indicator on the knob and fastening the dial to the panel.

Simplicity in design and operating control is the object of the designers of the new amateur apparatus, although the circuits employed and the methods are by no means elementary, involving the very latest commercial practice. While maintaining the very best appearance the present apparatus receives the same care with regard to the interior details, as is evident from some of the accompanying illustrations. Every effort is made by the designers to maintain a high standard of efficiency.

The receiving set shown in the first and second sections of the lower engraving on page 688 is typical of the best grade amateur sets now available. As will be noted in the rear view of this receiver, it comprises two variable inductances of the variometer design, a variable condenser, and a loose-coupler. This receiving set should be used in conjunction with a vacuum tube unit, such as the one shown in the third section. Such a unit contains the high-voltage battery for the vacuum tube, a variable resistance, a switch, and a receptacle for holding the tube inside the cabinet.

The other illustrations of apparatus represent a typical variable condenser of the highest grade, and a variable inductance in which the usual losses have been reduced to a minimum. It is such apparatus as this which is making it possible for amateurs to duplicate the work of commercial and Government stations, at least so far as receiving is concerned.

Instead of sliding contacts and long wire-wound tubes forming tuning coils and loading coils, the present equipment comprises neat cabinets or cases with bakelite fronts and simple knobs which can be readily turned for any desired adjustment. The rotary action has more or less entirely displaced the sliding action, except in the

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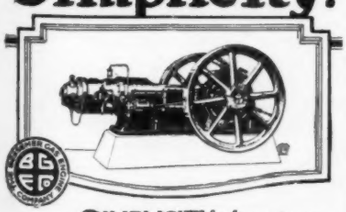

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But why call those engaged in this interesting work amateurs? When the United States went to war the Army and Navy had no difficulty in obtaining all the wireless personnel necessary for maintaining communications. Whereas European belligerents were obliged to train young men in wireless telegraphy, the United States had more men for this class of service than could be placed. Not only were they expert radio operators, but in many instances they were skilled radio engineers.

Amateurs in Name Only

The very men who are now designing amateur apparatus have designed apparatus for the United States and foreign Governments. The very men who are now returning to so-called amateur wireless have held important positions in our Army and Navy. There is very little about radio that they do not know, and even less that they cannot do. So it seems that the name "amateur" only serves to misrepresent them and their work, and a fairer name would be "radio experimenters" or "enthusiasts" or even "radioists." However, that is left to the amateurs themselves, who have heretofore been so engrossed in their hobby that they have cared little what the general public has thought of them, except at such times as their rights have been threatened.

Latest Patent Decisions

(*Continued from page 698*)

calendar could be placed each year, was in itself old. Such a removable calendar pad for the current year, with a tongue at its back adapted to engage on its back to a movable backboard, was also old. A metallic cap at the top of a calendar pad was also in prior use. The improvements made by the defendant in his patent consisted in widening the slot, in widening the tongue to completely fill the widened slot, and thus engaging the locking calendar and board in a firmer manner than theretofore. In his second patent the plaintiff placed lugs or ears at either end of the widened tongue, the functional purpose of which was to afford greater space, and consequently more permanency to the calendar sheets, where the nails went through the tin cap and bound the sheets together.

After careful consideration, the court is of the opinion these improvements were the natural advance incident to the art. It is true this plaintiff's cap made a more attractive looking calendar, one which had a firmer connection with the backboard than heretofore, and one which possibly gave a firmer and more effective hold to the sheets, by affording a larger margin on the upper side of the holes by which the sheets were held in place. But all of these improvements were in our judgment but the natural manufacturing advances in an existing art, where improvement was to be expected, in the comfort and attractiveness of office appliances which have in the last few years characterized the surroundings of business and professional work. Regarding the patentee's improvements as the natural growth to such art, the court feels they do not involve invention.

The decrees below are therefore reversed, and the cases remanded, with instructions to dismiss the bills.—*Eddy v. Kramer. 96 U. S. C. C. A. of Pa.*

By the statutes of New York a sealer of weights and measures is appointed in every county and every city by the local authorities, with the duty, among other things, to keep safely the stands and to seal and mark such weights as correspond with the standards in his possession. The statutes provide also for a state superintendent of weights and measures with, among other things, a like duty to keep the state standards, and "where not otherwise provided by law" to "have a general supervision of the weights, measures and

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(*Continued on page 704*)

Latest Patent Decisions

(Continued from page 701)

measuring and weighing devices of the state, and in use in the state."

The Standard Company manufactures a combination spring and lever computing scale which was then being used and sold in New York. It is equipped with a compensating device which is not automatic. Because of these "specifications," some county and city sealers of weights neglected to seal scales of plaintiff's make and warned scale users to discontinue the use thereof. A state inspector, who was a subordinate of the state superintendent, also marked some of these scales "slow and faulty." As a result, the Standard Company's business in New York was injured; sales diminished and collections for scales theretofore sold became difficult. The Standard Company contends that its scales with a mechanical compensating device are at least as trustworthy as those of its competitor with the automatic device; and it presented these views to State Superintendent Farrell, both before the "specifications" were issued and thereafter.

Held, that so-called "specifications" as to automatic computing scales are not a regulation of law within the prohibition of the Federal Constitution as to state legislation—their function being educational and at most, advisory.—*Standard Computing Scale Co. v. Farrell. Supreme Court of United States.*

The plaintiff in this bill in equity charged infringement of re-issue letters patent for an improvement in box strapping invented by Leon S. Howe. The bill further charged unfair competition. The District Judge sustained the patent, held that there was infringement, and dismissed the charge of unfair competition. The defendant denied that there was invention or infringement, but says that the patent in suit is invalid, because it claims, not a patentable combination, but a mere aggregation of old elements. It further claims that the re-issue patent is invalid because it shows new matter.

Box strapping, used by manufacturers and merchants, consists of metal strips intended to reinforce the ends of heavy wooden packing cases, to prevent them from breaking open. Ordinarily, these strips are nailed around each end of the packing case, and made to tightly embrace the case, so as to perform the intended function. As packages are frequently pushed and hauled over and about the floors of warehouses, railroad cars, or on the decks of ships, it is essential that the sharp edges of the strapping, and the nails which are used to hold it, be so guarded and protected as to avoid their catching in the floor, and thus prevent the strapping from being torn off the case.

Germany's Aircraft Experimental Station

AMONG the places visited by the Allied Naval Commission in German waters was Warnemunde, the great experimental station on the south coast of the Baltic about 100 miles east of Kiel. When the Commission visited the station there were close on 200 machines in the dozen or more sheds, practically all of them of new types, or old ones in process of improvement. The latter included some very useful looking Brandenburgs, Albatrosses, Frederichshafens, and Gothas, most of which seemed to indicate an effort toward lightness and speed rather than an increase of size. Light but very strong steel pontoons were the rule among all of these new machines. Generally speaking, they were less highly finished than similar British and French types, but there was no indication whatever that they had suffered through shortage of any materials. Aluminum—or, where greater strength was an object, the alloy, duralumin—were used lavishly, and even brass and nickel were not skimped. The camouflaging had been very cheaply and effectively done by printing a design—usually a hexagonal pattern, in which deep maroons and indigos predominated—directly upon the fabrics before applying the dope.

A powerful two-engined Gotha torpedo-dropping seaplane attracted a good deal of interest, less on its own account than because it was expected that the Germans would have given much attention to the development of this type. Of very late types, continues *Aeronautics*, there were several each of Travemundes, S.V.K.S., and Sablatnigs, none of them large, but all, in their trim lines and powerful engines, showing the constant effort to develop more speed. Especially interesting were two or three of the new all-metal Junkers, even the wings of which were made of corrugated sheets of duralumin. In these the mistake, noticed in the first one captured at the front, of having a machine gun mounted to fire through the bottom of the fuselage, had been avoided. Warnemunde's most spectacular exhibit, however, was a giant seaplane with four engines and with a wing-spread of something like 150 feet. Though this was greater than that of the great monoplane at Nordeny, it is not improbable that the latter had a greater wing area and perhaps a greater lifting power. No better idea of the size of the fuselage of this seaplane could be given than by mentioning that, in the courts of inspection, four of the Allied officers and 12 of the Germans were inside it at the same time, and that, standing on the floor, the writer could catch no glimpse of one of them.

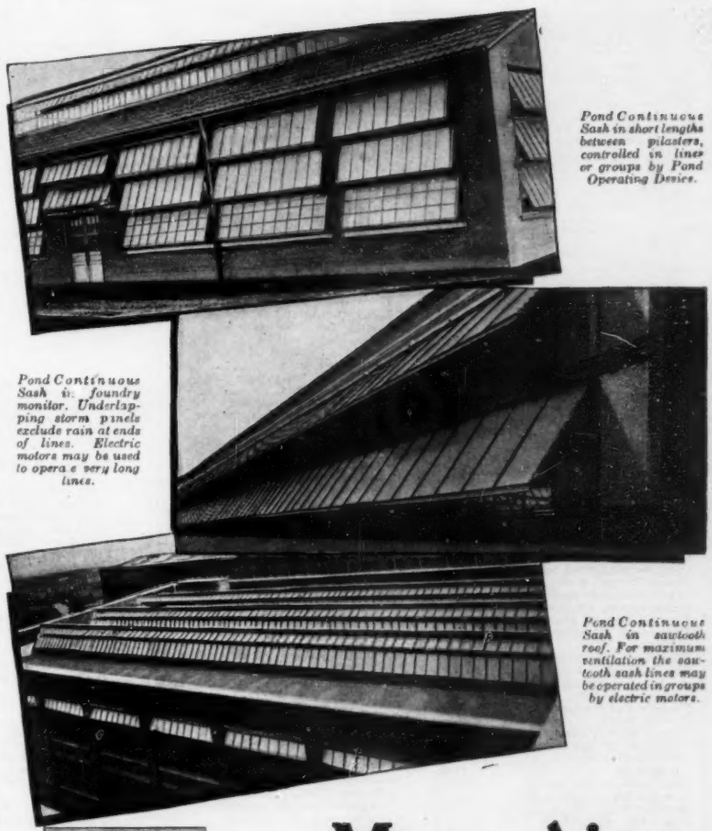
Subterranean Noises in Australia

SOUNDS resembling explosions which could not be traced to any mining or quarrying operation are heard at intervals in the Daylesford district of Victoria, says the Australian Geological Survey. The sounds are described as resembling thunder, or the explosions made in blasting rocks. They may occur singly, or two may be heard in rapid succession, and more frequently in wet than in fine weather. The noises are said to come from a portion of the Yandoit hills known as the Stony Rises, near a branch of the Green Gully Creek. The residents are of the opinion that they are caused by explosions of gas, and state that birds and rabbits which were supposed to have been suffocated by gas have been found dead in hollows.

This part of the parish of Campbelltown was not visited, but an inspection of the geological map of the parish shows that basalt has flowed down a branch of the Green Gully Creek, and remnants of the flow exist as a series of low hills. These trend down the creek, which may have eroded along the strike of the Ordovician rocks, or possibly along a fissure. Noises like those described by the residents of the district have been heard in many places in other countries, and are generally known as brontidi (like thunder); in India they are known as barisal (guns), in Mexico as bramidos (bellowings), in Italy as marina (sea shore).

It is not certain that the Yandoit noises are really brontidi, but it is not at all improbable that they are. The bearings taken indicate that the noises proceed from a part of the parish through which there apparently passes a line of weakness, the surface indications of which are a series of mineral springs, and on the southern extension of this line is a line of fissure eruption. It is possible that the noises originate along a fault line, that movements are yet taking place, and that these cause the sounds.

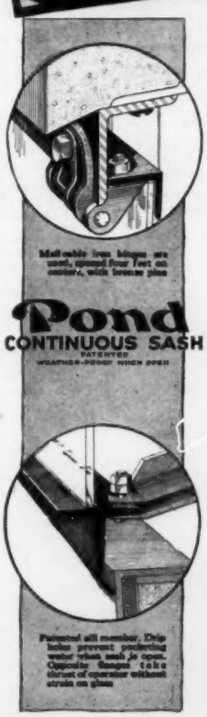
There is another possible explanation, in that the locality where the sounds are heard is volcanic, since the part indicated by the bearings is within five miles of Smeaton Hill, or Mount Kooroocheang, an extinct volcano where faults are known. About ten miles south of the place where the supposed brontidi emanate, three extinct volcanoes, Eastern Hill, Mount Prospect and Langdon's Hill, indicate a line of fracture of the earth's crush. If this line be projected northward, it would pass close to where the sounds originate.



Pond Continuous Sash in short lengths between pilasters, controlled in lines or groups by Pond Operating Device.

Pond Continuous Sash in foundry monitor. Underlapping storm panels exclude rain at ends of lines. Electric motors may be used to operate very long lines.

Pond Continuous Sash in sawtooth roof. For maximum ventilation the sawtooth sash lines may be operated in groups by electric motors.



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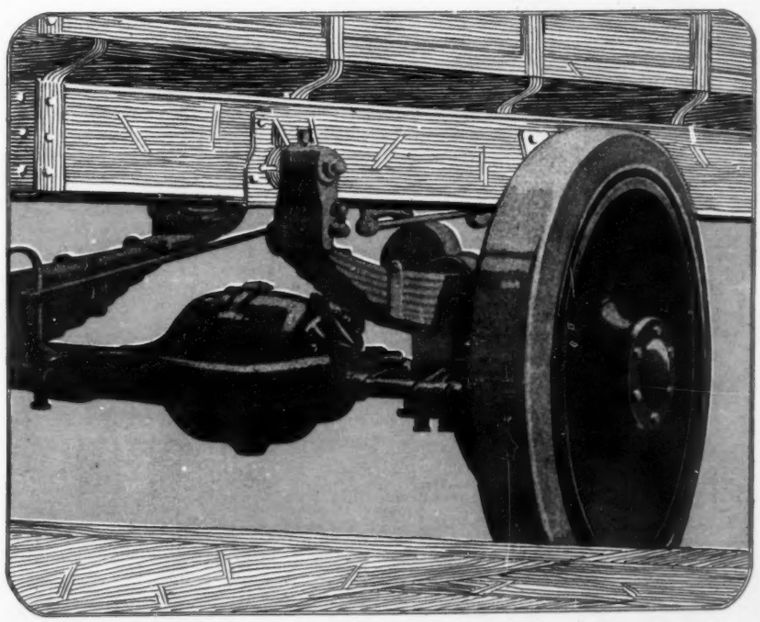

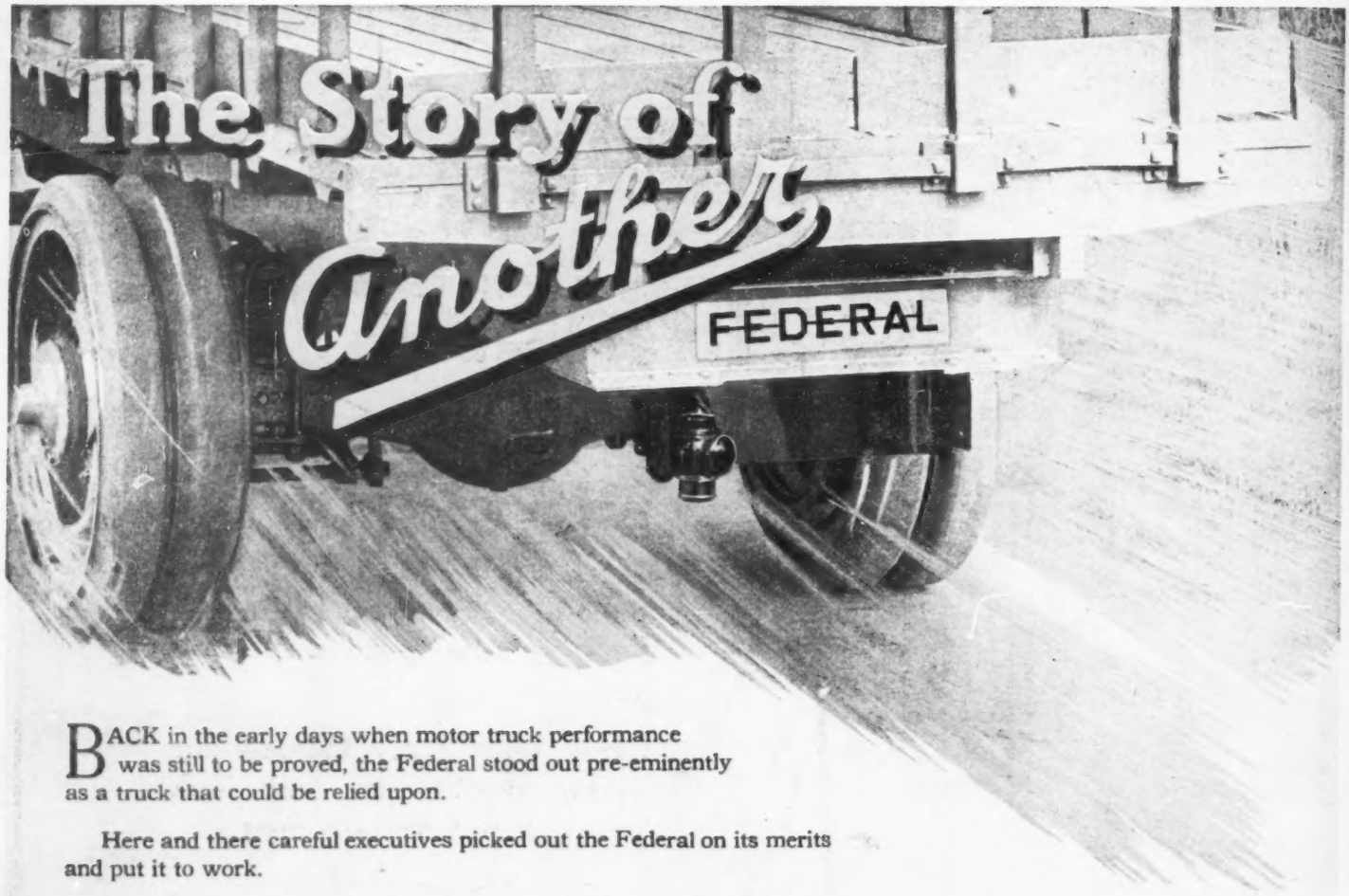

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